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THE MICROSCOPE.

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AN ILLUSTRATED MONTHLY MAGAZINE FOR THE STUDENT OF NATURE'S LITTLE THINGS.

Edited by

Dr. ALFRED C. STOKES (January-March),
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AN ILLUSTRATED MONTHLY MAGAZINE.

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ORIGINAL COMMUNICATIONS

THE ESOTERIC BEAUTY AND UTILITY OF THE MICROSCOPE.*

EPHRAIM CUTTER, LL. D., M. D.

I.

INTRODUCTION.—Three things prompt the writing of this paper:

1. It is the tri-centennial of the microscope.

2. It has been stated that not much has been done with the microscope in America, 1891.

3. At a meeting of the Presbyterian Clergy of New York, a few years ago, a divine repeatedly alluded to the "accursed microscope."

Now the writer feels that he owes a debt of gratitude to the Dutch for inventing the microscope—that America has done and is doing something with the microscope of great practical value, and that things of beauty and utility should not be called *accursed*. Hence he begs to testify what he knows in his own

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the lowest vegetable forms. Authors are not agreed about the cause of the motion. "The quivering oscilations of cocci are generally regarded as only Brownian or molecular;" —"some other observers believe that the movements of cocci are due to the existence of a flagellum" (tail). The idea that bacteria are instrumental in promoting the germinating process is not a new one; see Goodale's Physiological Botany, p. 469: "It is said that in soil that has been completely sterilized, that is, freed from microbes or their germs, seeds provided with all other requisites for germination will fail to sprout. These experiments by Duclaux have not been repeated by other observers." But the isolating of a specific form of bacterium in this special work, at its work in the cell, seems to me to be a new observation. We must conclude that these intercellular bacteria, which we have so often found thus at work, are developing that special ferment which is instrumental in germination. As we carry this subject along in thought, we see in other seeds, in all seeds everywhere, this or some form of bacterium working in the protoplasm of the cells for the same purpose during the process of germination. Right here the question for further thought and study is, Do these bacteria, by working directly on the starch grains, transform them into soluble matters, or do they perform this indirectly by developing the ferments to digest the starch gains?

We will now mount a section from a sprouted onion, which afterwards was frozen so that the leaves of the bulb presented a dead, sodden appearance. In this mount we see the protoplasm in the cells more distinctly than in the former series of studies. In this the protoplasm has separated from the walls and floats like cumulus clouds of a summer afternoon in the transparent cell sap, but showing no signs of life or motion, and no treatment that I know of will produce streaming, for we can not restore the dead to life. The *M. germinatus* are motionless or dead, and other forms of bacteria have commenced to work, on
e outside of the cells mostly, in the slimy, slippery fluid of
sition, and in this we observe numerous bacteria, of
forms. We measure them, 2, 3, 4, 5, 6, 8, 10μ long
sually less than 1μ wide, the larger individual
htly curved with squarish, blunt ends, sub-
: these are very numerous and very active,

often one end switching about violently, the other nearly quiet, occasionally turning somersaults. I observe comparatively few rapid swimmers. Here are some rods, with one or more nuclear points; they are individuals thinning off, ready to break up into separate parts; in other mounts we find them lounging lazily or moving more slowly; they seem to be all of one species, the length depending upon the age. They are light or translucent bodies containing light contents. In further study of them in soft, slimy, rotten onions, we find a great multitude to be from 3 to 5μ long and about .75μ wide. They are light, shadowy little fellows, very difficult to see, much harder to define than the protoplasm itself, which may, in certain stages of development, be seen with a first-class one-half inch objective; but this bacterium requires finer machinery and more careful handling; when the light is the very best, they can be seen through a one-fifth, but a one-eighth immersion is decidedly better. They appear either straight or slightly curved, according, as I believe, to their position in the line of vision; the number of curved ones would indicate that they are probably all curved. This and their shadowy dimness are leading characteristics. When they are first removed from the rotting onion (a drop of juice) and mounted in water under a one-eighth, they present a beautiful sight, darting about like a swarm of bees in their narrow space under the cover glass, a grand sight when they are very numerous. After watching them thus for about an hour, they quieted down to their ordinary state of activity. These specific bacteria are larger and different in form from either *Bacterium termo* or *B. lineola*, also very variable, but they are in the same brotherhood. I have no means of knowing certainly its identity, or whether it is new and undescribed or not, but this is probably the case. I can find no account of it; for our present use we will name it *Bacterium refringente*. As decomposition of the onion progresses, these bacteria become very numerous. A *Micrococcus* appears among them, and after about a week the field of the mount from the same onion is filled with large oval bodies, variable in size, an average being about 6 by 8μ. These are some unknown species of *Micrococcus* of large size, appearing at first sight very like mould spores. They possess light contents and a light spore or nucleus in each one, and a very thin cell wall;

they are occasionally in motion. This may or may not be imparted to them by the numerous *Bacteria refringentes* among them. They are of variable size, from 2 to 5μ in diameter (the globular bodies), but oftener they are ovals 4, 5, 6, 8, 9μ long by 3, 4μ wide; sometimes we find one much larger, containing two or three nuclei, the species perhaps new; if so, may it be named *Micrococcus giganteus.* When contrasted with the spores of the mould growing on one batch of these onions we observe the mould spores averaging larger, 6 to 10μ long, by 5 to 8μ wide, ovals with a thicker cell wall and yellowish, granular, protoplasmic contents and no nucleus, and growing on threads of mycelium, while the *Micrococcus* is in the juices of the onion and with no mould threads. By these characteristics we can distinguish them when mixed together in a mount. I kept one of my best slides three days in the same damp box with the slide of *B. refringente*, when I found it literally swarming with this form of bacterium; the water about the specimen was so filled with them that I scarcely saw any open spaces under five hundred diameters. These new individuals had very light shaded contents, and being younger were very much more active than those in the previous mount.

It has been hinted by one correspondent of THE MICROSCOPE that osmosis is the cause of the movement in the cells. To test this question, I mounted a film of onion in the expressed juice of the same onion to eliminate the possibility of osmosis, the mounting medium being the same as the cell sap, or at least its native environment. This, like the water-mounted specimen, was quiet at first, and for at least two hours while under observation. But after twelve hours I again had time to examine the specimen, which I found activity restored, and the streams of protoplasm flowing magnificently. It was one of the very best I ever saw; a sight hard to break away from even at the midnight hour. Here there could have been no osmosis, the medium in the cell and on the outside being the same. This mounting
um is the very best for this exhibition, but it dries out very
I found after twenty-four hours more that the proto-
gan to contract inwardly from the ends of the cells,
ighth to one-fourth of the length of the cells. The
ceased, but the little bacteria (*M. germinatus*)
on. At the end of the second day the separa-

tion of the protoplasm was still further advanced from the side walls of the cells; at the end of the fourth day the protoplasm had entirely given up the work and was completely separated from the cell walls and now floated in the limpid cell sap, usually in one irregular mass, the *M. germinatus* apparently dead. The cell sap is so transparent that we can see the partition walls very clearly; the gateways already noted in the cell walls are so demonstrably plain that I can study and measure them most satisfactorily, thus entirely convincing me that they are the openings for the inter-communication of the protoplasm from cell to cell. On the seventh day the *Micrococcus giganteus* began to appear in this onion-juice mounted specimen. The protoplasm is now breaking up into small irregular fragments, its structure becoming more coarsely granular—very likely little gas bubbles forming.

Summary.—1st. I feel persuaded that the observed phenomena of protoplasmic action and reaction, resembling shock after injury, denotes a form of sympathy between the several cells of the plant, amounting to something like the equivalent of consciousness, a form of knowledge of injury communicated from cell to cell, perhaps by sensation, or more probably by some sense unknown to us, yet implanted in our nature also, a consciousness in the protoplasm.

2d. The finding of our little bacterium, the *Micrococcus germinatus*, in all the living, healthy cells, most abundant and active when the onion has commenced to grow, and never after the protoplasm is dead, is convincing evidence that it is one of the working agents in the process of germination and which can not be excluded without imperiling the process.

MICROCOCCUS GERMINATUS, N. S.—Very minute granular bodies in the germinating cells, on and perhaps in the protoplasmic mass, all globular, from .5 to 1μ in diameter, the majority of them about or somewhat less than 1μ in diameter, containing darkish contents. Also other spherical bodies in the more advanced cells 2.5μ in diameter, with a nucleus. I believe these are advanced or older forms of the same species, but they need more study.

BACTERIUM REFRINGENTE (PROVISIONAL NAME, PERHAPS), N. S.—A bacterium coming after the death of the protoplasm and *M. germinatus*; observed in great numbers in the decomposing

onion cells, mostly rod forms 2μ to 10 long, by about 1μ more or less wide; sub-cylindrical bodies, the longer individuals slightly curved, ends squarish, often very active, especially in the young.

MICROCOCCUS GIGANTEUS (PROVISIONAL NAME, PERHAPS), N. S.—Cocci, very large, oval, oblong, or less frequently spherical, with a bright spore or nucleus variously placed; light translucent bodies with a very thin cell wall and clearish contents. Measurements of those of circular outlines 2, 3, 4, rarely 5μ, in diameter; of the ovals 4, 5, 6, 7, 8, 9μ in longest diameter, rare individuals much longer, by 3, 4, 5μ wide, or slightly more or less; the very longest specimens often contain two or three nuclei, but no chain-like forms; sometimes none of these would be seen in a dense field of the cocci. This is decidedly the largest, most bold-looking *Micrococcus* I have yet seen or have read of. It is magnificent. At first I thought I had large fields full of some mould spores. It occurs singly, often so numerous in old rotting onion bulbs as to fill the field of the microscope very densely in a single layer. It appears soon after the *Bacterium refringente*, also in the water-mounted slides kept for several days.

As the *Micrococcus crepusculum*, Cohn, is found in various putrefying fluids associated with *Bacterium termo*, Duj., so we find this *Micrococcus giganteus* associated with our *Bacterium refringente* in decomposing onions. The much greater size makes this to differ widely from the former pair. I find nothing in Crookshank's Manual of Bacteriology, last edition, 1887, to compare in size with our *Bacterium refringente* and *Micrococcus giganteus* in this working brotherhood of bacteria for the reduction of organisms to their primitive elements.

In offering this preliminary notice of my studies on the growth and decay of plants, as seen in the onion, I feel that much time is needed to get its complete history free from all error—much more time than I now have at command. I hope that many others, both present workers and new recruits, may carry the work onward.

THE NEW EDITION OF CARPENTER'S "THE MICROSCOPE AND ITS REVELATIONS," EDITED BY THE REV. W. H. DALLINGER, LL. D.*

THE first edition of the well-known "Carpenter" was published in 1856, the seventh in 1891, a new edition appearing on the average once every five years. From the first it took its place at the head of all treatises on the optical and mechanical construction of the microscope, and although similar books have multiplied, not one has equalled this, which has become the standard and a microscopical classic in the English speaking world of microscopists. No better book has ever been written with the action and the use of the instrument as its subject, none more comprehensive, none more learned, none less open to criticism. The reviewer might drop his pen at this point, and all would have been said; yet, whilst that might be just toward the book, it would leave the reader unsatisfied and the reviewer with much struggling for expression.

It was not long after Dr. Carpenter's horrible death in 1885, that a new edition of his classical work was desired by investigating and reading microscopists. The advances in microscopical optics had been so great, the model instruments had been so vastly improved, and objectives had undergone what so nearly resembled a revolution in structure, that the old book had become well nigh worthless as a reference manual. Not even in the last edition, which the lamented author himself revised, did he really and unqualifiedly accept defeat and a place on the losing side in the battle of the angles. He never emphatically taught that the widest angled objectives had won the day, as they even then had won it, and in this respect his work was lagging behind the microscopy of even ten years ago.

No such criticism can be made of the present edition. It is up to the present knowledge of this part of the subject; indeed, it goes beyond what some microscopists will be disposed to accept without at least some uneasy movement as they sit before

*"The Microscope and its Revelations," by the late William B. Carpenter, F. R. S., seventh edition, edited by the Rev. W. H. Dallinger, F. R. S. With twenty-one plates and eight hundred wood engravings. 8vo., pp. XVIII, 1100, Philadelphia: P. Blackiston, Son & Co. Price, $6.50.

their Continental stands and use their small-angled objectives over histological objects. At the first opening of the book they will come face to face with two phototypes that may not convince them, for they are "much set in their ways," but which are to the reasonable reader as convincing as that the noon-day sun is bright. In the frontispiece the key-note of the work is sounded. Here it is as heard in the explanation of the plate: "This object has been photographed for the purpose of exposing the fallacy which underlies the generally accepted statement that 'low-angled' glasses are the most suitable for histological purposes . . . On carefully examining this figure it will be noticed that it is almost impossible to trace the outline of any particular endothelium cell because its image is confused with that of the lower side of the pipe. In a monocular microscopical image a perspective view does not exist; it is therefore better to use a wide-angled lens, and so obtain a clear view of a thin plane at one time, and educate the mind to appreciate solidity by means of focal adjustment. It will be admitted that unless one approaches figure 7 with a preconceived idea of what an endothelium cell is like, the knowledge gained will be small indeed." In figure 8 is shown the same object (a small vessel from the bladder of a frog), with less amplification, but with a wide-angled objective. "Here only the upper surface of the pipe is seen, so that the outline of the endothelium cells can be clearly traced. The circular elastic tissue is also displayed."

The seventh edition of this microscopical classic is not only a new edition, but almost entirely a new book. It contains the latest microscopical information, presented in a pleasing manner, much abstruse mathematics prepared by a master hand for the easy assimilation of the less-learned reader, and its whole teaching is exactly what THE MICROSCOPE has been trying to teach its constituency, namely, get the best, aspire to the highest, and make the most of the optical tools at your disposal. In a personal letter to the writer, Dr. Dallinger, the illustrious editor, says in reference to the book: "The first seven chapters I have personally wholly re-written, giving an English touch to all the German theory, rendering all Abbe's work for twenty years into ...ope) an intelligible English summary, and giving the latest ...iples and practice, the technology of twenty-five years of ...ice in the use of the microscope, while I have strongly re-

vised (with skilled aid) every other chapter in the book, doubled the number of wood-cuts and put in nearly a score of new, colored plates." The latter are excellent lithographs, while the phototypes are nowhere else at the command of the reader unless he have access to the best of foreign microscopical literature. Here will be found a full-page phototype by Van Heurck of his best work with the new Zeiss objective of 1.63 N. A.; a full-page phototype of Zeiss's famous resolution of *Pleurosigma* magnified 4900 diameters; superb illustrations of the secondary structure of diatoms, with much more that is commendable and exceedingly welcome, while many of the optical diagrams are printed in two colors, so that the subject matter is made as simple, as plain, as easy of comprehension as a master-workman can make it. The reader has to exert but little effort on his own part to comprehend and, it is to be hoped, to appreciate this wonderful display of the latest and the best of things microscopical. That he will appreciate the editor's skill in so simplifying the abstruse should be a foregone conclusion. In reference to this Dr. Dallinger says: "In the following pages we propose to treat the elementary principles of the optics of the microscope in a practical manner, not merely laying down dogmatic statements, but endeavoring to show the student how to demonstrate and comprehend the application of each general principle. But in doing this we are bound to remember a large section of the readers who will employ this treatise, and so to treat the subject that all the examples given or that may be subsequently required by the ordinary microscopist, may be worked out with no heavier demand upon mathematics than the employment of vulgar fractions and decimals." Therefore, the intelligent amateur, or even the intelligent novice, need have little fear of the book as of something ponderous and consequently repulsive. It is learned, it is simple as a natural result, and the microscopists that master it will be well-informed indeed. And every student can master it.

For the amateur, Dr. Dallinger has "a fellow feeling." Without the amateur there never could have been the microscope of the present day. Without the amateur our objectives would have, perhaps, remained as they were in the days of French Triplets. Without the amateur to start the ball rolling there could never have been the professional to keep up the move-

ment. On this point Dr. Dallinger says (italics his): "It is largely to amateur microscopy that the desire and *motive* for the great improvements in object glasses and eye-pieces for the last twenty years is due. The men who have compared the qualities of respective lenses, and have had specific ideas as to how these could become possessed of still higher qualities, have been comparatively rarely those who have employed the microscope for professional and educational purposes. They have simply *used* —employed in the execution of their professional work—the best with which the practical optician could supply them. It has been by amateur microscopists that the opticians have been incited to the production of new and improved objectives. But it is the men who work in our biological and medical schools that ultimately reap the immense advantage—not only of greatly improved, but in the end of greatly cheapened object-glasses. It is on this account that the amateur microscopist should have within his reach a handbook dealing with the principles of his instrument and his subject."

The book contains no "padding." The fact is especially manifest in the chapter treating of accessory apparatus. Here the editor had a chance to make the book two or three times as large as it is by describing all the superseded optical appliances of the past, with all the useless suggestions of the present, that see the sun in the periodical literature of the time only justly to die at a touch of the light. Nothing but the essential and the best now in use is referred to; all that are unimportant or that have been supplemented by better being omitted.

The readers of THE MICROSCOPE for the last two years have become familiar with the beliefs and the suggestions of a writer who has thought it best to write under the pseudonym of "An Amateur." This gentleman has in an emphatic way condemned the microscope stand called the "Continental," and for this he has been subjected to some severe, not to say rabid, criticism. He acted according to his belief, and had the courage of his
ctions, feeling that the teaching was correct and could, in
ie criticisms of prominent histologists, do nothing but
he has been disposed to defend himself, yet he need
that much effort if he could have known what so
y as Dr. Dallinger would have to say on the
nth edition of the authoritive Carpenter. It

is this, the italics being his: "THE CONTINENTAL MODEL.—Our one purpose in this treatise is to endeavor to promote what we believe to be the highest interests of the microscope as a mechanical and optical instrument, as well as to further its application to the ever-widening area of physical investigation to which, in research, it may be directed. To this end throughout the volume, and especially on the subject of the value and efficiency of apparatus and instruments, we have not hesitated to state definitely our judgment, and, where needed, the basis on which it rests. Incidentally we have expressed, perhaps more than once, our *disapproval*, and with ourselves that of many of the leading English and American microscopists, *of the form of microscope known as the Continental model;* and we cherish strong hopes in the interests of the science of microscopy that so enterprising and eminent a firm as that of Zeiss, of Jena, will bring out a model that will comport more completely with the needs of modern microscopical research than even the best of the models that they now produce. * * * And when we know that the 'Continental model' has in the hands of Zeiss passed from an instrument without inclination of the body into an instrument that does so incline, and from an instrument without sub-stage or condenser into one provided with the latter of these absolutely indispensable appendages, and finally from an instrument with a perfectly plain stage with 'clips' into what is now a stage with mechanical movements—we can but hope that these concessions to what has belonged to the best English models for over forty years, may lead to an entire reconstruction of the stand—a wholly new model—intended to meet all the requirements of modern high class work in all departments, and with a fine adjustment of the most refined class." This should be enough to show that the Continentalists can not be an increasing factor in the advanced microscopy of the present day, but Dr. Dallinger gives them six octavo pages more of the same commendable opinion.

That the sub-stage condenser should be used in all classes of work is strenuously insisted upon, and that it should be used with its full and largest aperture and accurately focused, so that the posterior lens of the objective, as the microscopist looks down the body after removing the eyepiece, should be seen to be three-fourths full of light. That this is correct teaching

and good there is not the least doubt; the question is in no way open to discussion; but that the condenser can be so used, and that the objective will bear the strain, are matters which experience shows cannot be accomplished without specially fine lenses, nor without screens of the properly colored glass. Without the latter, no eye can endure light of such intensity, and to get the glass of the proper color to be placed between the source of illumination and the condenser is not an easy matter. Mr. E. M. Nelson failed to find the proper kind in England, and was compelled to go to the continent for it, although Dr. Dallinger says nothing about that. And it cannot, according to my experience, be obtained in this country. The glass should be, it is said, cobalt blue pot metal, but as that can be found only in Europe, and after a special search, what is the microscopist to do? There seems nothing, except to lose some of the advantages of a focused condenser, possibly all of the advantages of a critical image, and to use the accessory racked down beyond the focus. And none but the best objectives are sufficiently well corrected for spherical aberration to bear such a test; with most lenses, good lenses otherwise, the object under these conditions is lost in a fog to be dissipated only by reducing the illuminating cone by diaphragms, or by racking down the condenser. What can be done with the properly colored screens and a focused condenser, I do not know, as the right kind of glass is not procurable, that to be obtained being either too dark, thus making the light too dim, or not dark enough. Upon the use of these screens and upon the proper color of the glass, Dr. Dallinger is not sufficiently explicit. This is as important as are the instructions which he gives for the proper and ordinarily impracticable use of the condenser. A suggestion from so great an authority that the opticians should obtain and supply the proper glass for the modification of the light, so that an ordinary eye could bear and utilize it, would probably have been followed by good results, and microscopists would then be able to learn what good objectives, although perhaps not apochromatic, would do under such conditions. This is one of the minor defects in an important section of the book.

Referring to one of Bulloch's stands the editor says (italics mine): "It presents no special point, save the employment of a condenser with the diaphraghm drum *above the len-*

ses!" Dr. Dallinger has here fallen into error. Bulloch's Gillett diaphragm is bad, but not so bad as that. It cannot be used above any condenser, and was never intended to be so used, as the lamented optician himself informed the writer.

Another criticism which, in the reviewer's opinion, may justly be made, is in the sequence of the first three chapters. To begin with the elementary principles of microscopical optics, as the book does, passing to the second chapter on the principles and theory of vision with the compound microscope, thence leaping to the history and evolution of the microscope, and thence, in chapter IV, to accessory apparatus, does not appear to be a logical arrangement. It would have been better to have made chapter III (the history of the instrument) the first chapter; chapter I (on elementary optics) the second, and chapter II (the theory of microscopical vision) the third. These parts should at least be read in this order.

Dr. Dallinger in several instances uses the word 'microscopic' to describe the objective, referring to the "microscopic objective" and to "microscopic vision," neither of which he means; indeed some objectives are not microscopic enough, some of Tolles's, for instance, being unnecessarily macroscopic. The editor also uses the far-fetched word "reflexion" in every instance instead of the usual "reflection." It seems unnecessary to drag this old thing from its merited seclusion, and why Dr. Dallinger should have done so is a mystery. At the first meeting with it the reader is forced to pause to get the meaning, while to meet it on almost every page soon becomes an annoyance which, like the continuous pricking of a pin, finally grows to obscure the horizon. But these and some similar points are small defects in a book which is a monument to the editor's learning, skill, patience and astonishing capability for hard work.

ELEMENTARY MICROSCOPAL MOUNTING.—III.

DR. A. M. WEBSTER.

CEMENTS.

Although it is possible to mount an object with a slip, a cover glass and some resinous medium that shall surround the object and, after its volatile matter has evaporated, become hard, it is always well to use a cement in addition, either to form a cell or

to encircle the edge of the cover. This ring of cement not only adds to the appearance of the slide, but it holds the cover in place and prevents the loss of the mounting medium when that medium happens to be a liquid that does not become hard by the evaporation of some of its parts. A cement, therefore, is an important thing to the microscopist that mounts his own objects, and it should possess certain qualities, without which it may be useless and dangerous; dangerous because, after the microscopist has applied it and relied upon it to keep the mount in good condition, it may crack or chip from glass, or become so brittle by drying that a slight shock to the slide may make it and the entire mount leap into the air. This is not a rare occurrence with certain mixtures sold by the dealers and recommended in the books. A good cement should be sufficiently fluid to flow readily from a camel's hair brush; it should dry quickly; it should cling firmly and evenly to the glass; it should not easily crack, so as to allow the air to enter or the liquid mounting medium to exude, as some media have the great tendency to do, and it should have no affinity for the mounting medium that it surrounds, and no chemical action upon it.

But these are qualities which the beginner will learn about by experience after he has made the mount and laid it aside for a time. Yet there is another quality which will make itself apparent immediately, and it will be one of the greatest annoyances to the beginner, as it continues to be to the advanced worker. This is the tendency of the cement to run under the cover and to spoil the preparation. There are exceedingly few cements that will not do this reprehensible thing. The microscopist prepares his object, and with a good deal of pleasant anticipation applies the cement around the edge of the cover, and he has the chagrin to see the stuff slowly but surely begin to creep under and gradually to spread through the whole preparation, or at least far enough to ruin the appearance of the mount, if it does not destroy the object itself. A cement that has the greatest tendency to keep where it is placed and shows the least tendency to run under the cover is, other things being equal, the best for mounting purposes. But the cement that will never run under does not exist. It is for the careful microscopist to use so carefully those that he selects that they shall rarely or never do this obnoxious thing. Yet every mounter of

microscopical objects, even the most advanced, is likely to meet with the trouble. At the beginning of his career he will meet it at the start and suffer severely from its ravages. But care and intelligence will reduce the abominable trait of all microscopical cements to subjection. Still, there are some that have the undesirable quality more fully developed than some others.

To fasten down the cover over a preparation mounted in a fluid is an important function of the cement, but to build up a cell to hold the object and the surrounding medium is as important, and one with which the beginner should early become familiar. The weight of the cover, thin and light as it is, would often be heavy enough to crush the delicate object and make it unfit for microscopical study. The microscopist aims to have his specimens, so far as the structure and the arrangement of the parts are concerned, exactly as nature made them; a crushed and distorted object may not tell the truth as to the structure and arrangement of the parts. The object must be protected from the weight of the cover while the cover itself protects it from outside influences. A cell must therefore be made deep enough to hold the object and the preservative medium, and high enough to lift the cover an infinitesimal distance above the object. This distance must be microscopic or it may make the cell so deep that the object will float about in the mounting medium, if that is a fluid, and may, when the slide is placed on the stage of the microscope, slowly glide down to the lower edge and so interfere with the examination. A cell that is too deep may also interfere with the action of the objective by removing the object so far from it as to prevent the proper focussing. Some objectives have a very short focus, and the cell must be made accordingly. For some of these very high power and short focus objectives, the object is often mounted on the lower surface of the cover, without a cell, so as to bring it within optical reach of the lens. This is always done with the test diatoms that are used to show the good qualities of certain objectives, and the mounting medium is usually Canada balsam, or something similar that will become hard when dry, and so lift the cover a minute distance above the slide to protect the object from any destructive pressure from the weight of the protecting glass, and thus take the place of the cell. This mounting on the cover is not often necessary with ordinary objects for study with even

excellent lenses. It is only the tests which are usually so mounted.

If the microscopist uses square covers for his mounts, as he may, he must of necessity make square cells. A circular cover will not consent to be applied to a square cell, and a circular cell will not act well with a square cover glass. It is here a case of like to like so far as form is concerned. But to make a square cell a pattern is necessary. This may be easily made by drawing with ink a square on card-board and placing the slip above it. The square cell may then be prepared by the application of the brushful of the semi-fluid cement, and set aside to dry. If the worker's hand be steady the result will be satisfactory; otherwise it will have a very shaky appearance. If one application of the cement does not make the cell deep enough, as it probably will not, other layers may be added after those beneath are dry, or nearly so. In this way, by the application of successive coats, a cell of almost any depth may be built up. This method is also applicable to circular cells. They too, may, be made as deep as is desired by adding layer after layer, although it demands some skill to do this cell building by free hand and have the result satisfactory. There are consequently other and better methods of making deep cells. Unless the cement is of extraordinary tenacity and firmness, these deep rings are apt to be disappointing, because they will leak in time, and often in a short time, letting the air in and the medium out; the slide is then a sad thing to contemplate. For deep cells to hold very thick objects it is better to use a method to be referred to hereafter; but for fastening down the cover and for making shallow cells, cement is always used, and if it is good, nothing more is needed.

Some microscopists are fond of trying every new cement recommended in the books and in the journals. A new cement may seem to be a success in the hands of the inventor who is in such a hurry to recommend it to the world of microscopists that he does not give his invention a chance to show its qualities; but because it stands the wear and tear of a short time he concludes that it is a fine thing, and gives it to others; and some of us are disposed to try every novelty of the kind that comes

This is not to be commended. It is far better to select one cement, or perhaps two, which have been thoroughly

tried by an army of microscopical workers, and then stick as fast to it as it shall stick to the slip and the cover glass. You will learn by the experience that has always been the best teacher, what are the qualities of the cement, how it must be treated to have it always act its best, and how it must be kept so that it may be disposed to do that best. All the innumerable cements in the market and in the books, demand good treatment or they will do poor work or none. If left to themselves without any attention for months, they will not be in a condition to respond to your calls. They are all made with volatile ingredients so that they shall dry rapidly, and they preserve this quality when they are left to themselves for a long time. The volatile matters will escape through the stopper, the cement in the bottle will become as hard as a rock, and the microscopist that uses it but seldom and neglects it in the meanwhile, will be disgusted. Cements should be looked after occasionally to see that they are not drying away.

There is another annoyance that the microscopist has to contend with and one that should not be required of him. Most of the cements and mounting media bought of the dealers are in bottles with cork stoppers. The stoppers should be of glass. When the cement gets a little hard for the want of attention, or when a little has been left on the neck of the bottle, the cork sticks fast with a firmness worthy of a better cause; and to get it loose it must be twisted and bored and torn, the result being that the cement or the mounting medium is filled with cork cells that are sure to give trouble. If the stoppers were of glass, this cork cell nuisance would be obviated, and if the glass stoppers had any tendency to stick fast in the neck, as they probably would if a drop of cement were left there, this might be prevented by slightly smearing them with a little vaseline. This is a good application for corks in cement bottles. Rub a little vaseline on the cork and its tendency to stick and so to destroy the microscopist's disposition, will be reduced, and the volatile matters in the cement will evaporate no faster than with ordinary stopers.

It is generally best to fasten down the cover glass with the cement used to make the cell. There are some rare exceptions to this rule, the most common being in the use of some ornamental colored material as a finishing touch to the mount. And it not

rarely happens that this ornamental finishing touch is just the thing that ruins the appearance of the slide. Nothing can be neater than a well-mounted slide without those circles of gilding or of red or yellow paint that are sometimes seen on otherwise commendable preparations. Such rings are unnecessary, and unless used with great discrimination they detract from the pleasing aspect that a slide may easily possess if the preparer has a little good taste. It is rarely in good taste to paint colored rings on the cement, nor to use highly colored cements. Some microscopists contend that the object is as valuable in a badly mounted slide, where it is nearer one end of the slip than the other, where the Canada balsam or other resinous mounting medium has been allowed to run over the glass and to dry there, and where the whole aspect of the slide is disreputable and unwholesome. In such cases the object may be valuable and important, but it would not be injured by a little attention paid to the appearance of the slide itself. Microscopical work is neat and clean, and the microscopist's slides should be no exception to this rule. The beginner will do well if from the first he shall try to mount well, and to finish his slides neatly. Gaudy rings and highly colored cements are to be deprecated, but neatness is always a recommendation in every walk of life. I should, therefore, recommend that a single cement be used to make the cell and to finish the mount.

The following are in common use. I shall try to point out their good qualities and their bad ones, according to my experience with them. There is an innumerable hoard in the market and in the books, but with the following the microscopist will be prepared to do almost any kind of mounting, and after he has used some of these until he has become familiar with mounting processes he may then experiment for himself, and perhaps invent several others that shall be better than anything else in the world of microscopical cements. Until that time arrives, however, let me repeat that it seems best to select one or two and to use them exclusively, so as to become familiar with what they will and will not do.

BRUNSWICK BLACK.

"a perhaps the oldest of all the recommended micro-
It is usually the first that the reader will

meet with in the books devoted to the use of the microscope, and it is for many purposes one of the best, if properly made, and one of the worst if not properly made. It cannot be prepared at home, but must be always bought. Its composition is asphalt, linseed oil (as a dryer), a little India rubber to reduce its proneness to crack, and turpentine. It dries readily, with a glossy black surface that is exceedingly attractive, and is in many ways the best cement for general use in making cells, although for finishing the slide it has one tendency which makes it obnoxious. By the addition of turpentine, if it gets too thick, it can be made to flow readily from the brush, and, many microscopists to the contrary notwithstanding, it does not readily crack, nor easily separate from the glass. It is a trustworthy cement, but that fatal tendency of running under the cover is an objection that must be remembered. According to my experience, Brunswick black will run under rather easier than any other cement, except, perhaps, zinc white, to be considered hereafter.

For making cells of moderate depth it is excellent, and if the worker will give the cell a thin coat just before he is ready to apply the cover glass, and after he has the object ready for that application, he can gently force the cover into the fresh layer so that when it is dry additional coats may be applied without risk. But to place the cover on the cell that is entirely dry and then to add the cement as a finish, is to invite disaster in the form of the running under of the black liquid, and the disfiguring of the mount if not its destruction. It is pleasant to work with, as it dries rapidly and presents so beautiful a surface, but it must be used with its perverse character always in mind. In making cells with it the brush may be well filled, if the cement is in good condition and not too thick, and the ring made at one sweep, but when fastening down the cover it is better to use a brush but slightly charged with the cement, and to add several coats in succession. In this way it may be mastered, and the result will be pleasing. If well made it will not crack nor allow the cell to leak; yet here, as with other cements, it is well for the microscopist to look over his cabinet of slides at least once a year, and to give a fresh coat to those that seem to be in need of it. Good slides may thus be kept in good condition, while weak ones may be treated and saved from total extinction.

Objections have been made against the method of applying a

thin layer of fresh cement to a cell already hard and dry, some of them being entirely imaginary. Yet there is one valid criticism to be made, and one result to be avoided. This is, that unless the cover is applied at the first trial at the exact point on which it is to remain, the fresh cement will be smeared over the lower surface and so mar the appearance of the mount, and often its usefulness as well. The cover will surely be soiled if it is moved ever so slightly on the fresh cement. To avoid all danger of this kind it is better to use an old and dry cell without the addition of the live cement, however thin it may be. To do this and pretty surely prevent the entrance of the cement into the cell, after the thin glass has been added, an application of gum arabic mucilage may be made around the edge, and when entirely dry and firm, but long before it begins to crack, as it will speedily do, the Brunswick black to finish the mount may be confidently added, as the hardened mucilage will prevent its running under. Should the mucilage itself have a tendency to penetrate into the cell, it will not be so obnoxious in appearance and effect as would the black cement. But if it is used in a thick solution, or is applied in a thinner one in several layers put on very carefully, this objectionable feature will not become prominent. To accomplish the same object some microscopists add a layer of paraffin before applying the finishing black cement. The paraffin must be used while it remains fluid after being heated. It may be applied with a hot wire. It hardens as soon as it touches the glass; yet mounts may be made with Brunswick black and without the application of any protecting medium beneath it. But this demands care.

Microscopists that take an interest in the construction of the objectives they use, and what microscopists do not, especially if they employ the best at their command, will surely read with a sense of satisfaction mingled with regret and with a certain

chagrin, that, as mentioned on another page, M. Albert Brun, the professor of chemistry in the University of Geneva, has discovered a method of making opal of such a character that it may be used instead of the untrustworthy fluor-spar for the making of apochromatic objectives. Diamonds have been artificially made by a very expensive and laborious chemical process, but opal making appears to belong to another category, and to be beyond a peradventure.

At first glance the discovery seems to be for the advantage of microscopists in general, but those that have read of the fluor-spar *exposé* will recollect that Zeiss has practically a monopoly of all the optically available flourite of the world. It is therefore impossible for other opticians to make actual apochromatics It remains equally impossible for any optician, except Zeiss, to use the newly discovered, artificial opal, since he has acquired both the process of manufacture and the sole right to use the material. Any hope that may have glimmered along the microscopist's mental horizon that American or British opticians might make apochromatic objectives with opal lenses amongst the glass, must flash out into the darkness of disappointment. Those that might want an opal apochromatic objective must probably pay, as they have paid for the fluorite lenses, almost its weight in hard earned gold. Yet there is one satisfaction. No opal apochromatic has yet been made. It is known only that the artificial material can be used, that it can be prepared in sufficient quantity and of the proper size, and that it possesses all the good qualities of fluor-spar with none of its softness, its obnoxious, exfoliating and pitting ability, and with none of its rarity as an optically available mineral. What an opal objective may do or not do, no one can guess. It may do nothing good. Let us comfort ourselves with that improbable conjecture. It may be superior to the apochromatics. In that case—well, in that case, perhaps the fluorite objectives may be a little cheaper, or may be made in this country, and the American ones may not pit and scale off in little flakes; perhaps—but what a queer thing the imagination is, to be sure!

ACKNOWLEDGMENT.—To Mr. F. Dienelt, Loda, Ill., for three slides of the anatomy of the honey bee. These are the result of much careful dissection, work in which Mr. Dienelt is expert.—

To Dr. J. E. Talmage, Salt Lake City, for beautifully finished photo-micrographs of *Artemia fertilis* from Great Salt Lake, and of the head of *Tænia crassicolis* from liver of brown rat.

NEWS · FROM · THE · WORKERS ·

NOTE ON SEMI-APOCHROMATIC OBJECTIVES.*—Of late years optical progress in the making of microscope objectives has been great, but all is not yet accomplished, and Dr. S. Czapski, of Jena, in a recent article, has stated with much clearness what it is still desirable to do.

Zeiss's apochromatic objectives mark a considerable advance toward perfection. They have the advantage of being well corrected for the spherical aberration due to those rays which have the greatest chemical action, as well as for those which make an impression on our retina. It therefore happens that to the eye the visual field of the microscope presents more light, whilst the distinctness of the image is very great; still, as M. Czapski has well remarked, these apochromatics have in reality but a slight advantage over homogeneous immersion objectives. But for the making of photographic negatives the advantage is, on the contrary, considerable, and experience will more and more conclusively demonstrate the great superiority of the apochromatics for photo-micrography.

But these lenses have three objectionable features: 1st. Their price is very high. 2d. The glasses used sometimes undergo changes. These are the phosphates and the borates which, under diverse atmospheric influences, and especially under the slow action of water (even when vaporised), tend toward crystallization. These glasses then become more or less true and worthless. We should state that Zeiss has always changed, free of expense, these altered objectives, and that recent glasses furnished by the Schott works only rarely

J. Brun.—Journal de Micrographie.

undergo the change which has been called the apochromatic disease 3d. The third inconvenience inherent in these lenses is in the layer of fluor-spar there used. This soft, exfoliating material makes them delicate and fragile.

M. Albert Brun, chemist, Licentiate of Science, has this year [1891] succeeded in artificially producing a substance having almost exactly the properties of flour-spar, but harder and more resisting. It is opal, a rare gem, found in Nature only in small pieces, and, in a word, too dear to be used practically. (See *Archives des science physiques et naturelles*, Geneva, June, 1891.)* I read in that article that "the house of Carl Zeiss has acquired the right to make and to use this artificial opal for optical purposes."

We should also speak of the progress of a very desirable consummation, that of making the objectives at a lower price. I have this year had occasion to visit the workshops of M. Koristka, an optician at Milan, and I have admired the precision with which his instruments are made. His mountings, his iris diaphragms, his micrometer screws, etc., leave nothing to be desired so far as mechanical perfection is concerned. This optician has appreciated the advantanges of the apochromatics for direct observation with the eye, setting aside the optical combination useful for photo-micrography. With this object he makes a 1-15-inch homogenous immersion objective which he calls "Semi-apo," and which he sells at the moderate price of 200 francs [$40.00], including two compensating oculars.

This objective is very advantageous to those that do no photo-micrographic work. The illumination is admirable and the definition exceedingly sharp. Slightly oblique light resolves the striæ of *Navicula crassinervis* (*Frustulia saxonica*), and with axial illumination the fine striæ of *Surirella gemma* are resolved into pearls. The objective is well adapted to natural

*M. Albert Brun has succeeded in making artificial opal, in transparent, colorless, homogeneous and amorphous masses. He has determined the following optical constants. * * * * These values are in accord with what Prof. Abbe has found for different kinds of natural opal. "We remark that among vitreous substances the artificial opal is one of those whose index is the smallest. The process of manufacture produces pieces large enough to be conveniently used in the construction of optical instruments. The house of Carl Zeiss, at Jena, has acquired the right to manufacture and to use this artificial opal for optical purposes."

history and to bacteriological work, and by its low price it realizes a progress which I think it proper to encourage.

With the excellent apparatus of MM. W. and H. Seibert, of Wetzler (vertical illuminating apparatus),* this objective readily resolves a dry mounted *Amphipleura pellucida*, not only into striæ but into heads.

WAYS AND MEANS

A NEW METHOD OF STAINING.†—Martinotti's solution is made by saturating alcohol with picric acid and with nigrosine. Two parts of this solution and one part of aniline water are mixed together and allowed to evaporate in the open air. The crystals deposited are dissolved in proof spirit. This is also evaporated and olive-green, cubical crystals obtained soluble in water, in ether and in alcohol. With them is made a 2 per cent. solution, in alcohol for tissues, in water for micro-organisms. Sections are first stained by Beale's or Orth's carmine, decolored in acidulated alcohol, washed in water, dehydrated and placed in the alcoholic solution of picro-nigrosine, where they remain for from 2 to 10 minutes till stained chestnut brown. Decolor in an alcoholic solution of oxalic acid, dehydrate, clear, and mount in balsam. By this the nuclei are stained red, the protoplasm deep yellow, the connective tissue light green, elastic fibres violet, the cartilaginous substance yellow.

To stain micro-organisms within the tissues, after coloring with carmine, decolor by Gram's method (or that of Koch-Ehrlich for *Bacillus tuberculosis*), and place for 5 minutes in an aqueous solution of picro-nigrosine, finishing as already described.

*MM. Seibert's vertical illuminating apparatus was invented and made twenty years ago by Messrs. R. & J. Beck, of London. It is the "Vertical Illuminator" which has been for that length of time used in England.

†The forgoing footnote is added by the editor of the *Journal de Micrographie*, has fallen into error by giving the Messrs. Beck credit for the invention Vertical Illuminator. It is the invention of Prof. Hamilton L. of Geneva, N. Y., the American authority on the Diatomaceæ.—THE MICROSCOPE.]

rma Medica. Cf. Bul. Soc. Belge de Micros.

A NEW STAINING METHOD FOR THE CENTRAL NERVOUS SYSTEM.*—Pieces of the nervous tissues are placed for 5 weeks in a mixture of equal parts of a 1 per cent. solution of chloride of gold, and a 1 per cent. solution of corrosive sublimate. Sections are cut in dilute ($\frac{1}{4}$) Lugol's solution. (*On les coupe alors dans la solution de Lugol diluée* ($\frac{1}{4}$).) The fibres with or without myaline, the nerve cells and those of the neuroglia are colored blue. In the ganglion cells the nucleus and the nucleolus are plainly visible.

FLAGELLA OF MINUTE MICROBES.†—It is not difficult, says Mr. G. F. Dowdeswell, provided that an appropriate, but quite ordinary means be adopted, to demonstrate the flagella of minute microbes, for example, the comma forms. The first to do this was Mr. E. M. Nelson, who showed them in 1886, at a meeting of the Royal Microscopical Society. The optical apparatus required are a normal retina, a good objective with a moderate angle of aperture, and a good light. For staining purposes gentian-violet answers as well as any other color, but it is necessary to be particular as to the method of mounting. The specimens must be mounted in a solution of acetate of potash, and not in balsam. By this method no difficulty will be experienced in demonstrating flagella of miorcbes as small as *Bacterium termo.*

A METHOD OF ILLUMINATION.—Mr. J. A. Perry, writing to *Science Gossip*, describes a method of microscopical illumination which is simple and said to be very pleasing. It is produced by a disk of ordinary cover glass ground on both sides, and used in the same place and in the same manner as the ordinary black-ground stop below the sub-stage condenser, the marginal rays of light passing unobstructedly around the outer edge of the ground cover glass, producing a different and far more pleasing effect than that produced by the ground glass extending over the whole aperture of the condenser, and entirely different to that produced by a ground glass cap over the top of the condenser. It is a very pleasing mode of illumination on almost all objects usually viewed with a black ground, as well as those objects viewed by direct light.

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*Neurol. Centrab. Cf. Bul. Soc. Belge de Micros.

†Annals de Micrographie. Cf. Journ. R. Micr. Soc.

NEW PUBLICATIONS

MENTAL SUGGESTION.—By Dr. J. Ochorewicz. Four double numbers of the Humboldt Library. Price $1.20. The Humboldt Publishing Co., New York.—Much is now-a-days said and written about hypnotism. It is the common belief that whatever of truth there was in the doctrines of Mesmer and the rest of the "animal magnetizers" is comprised under the scientific term "hypnotism," and that the modern school of "suggestionists," represents the highest attainment in the science and art once studied and practiced by Mesmer and Puysègur, and later investigated by Braid, of Manchester. But here is an author who maintains that hypnotism and animal magnetism, though they have certain superficial resemblances, are radically different from each other in their phenomena and in the modes of their production, and that the facts of magnetism are incomparably the more wonderful and the more worthy of scientific study. The title of the work, "*Mental* Suggestion," well marks this teaching as to the difference between hypnotism and magnetism. The author is a learned physiologist and physicist, as well as psychologist, and he has studied the matter experimentally for many years.

SOME CLINICAL FEATURES OF STONE IN THE BLADDER.—By L. Bolton Bangs, M. D. Reprint.

PHYSICAL CAUSES OF HEART DISEASE AND TREATMENT.—By Ephraim Cutter, LL.D., M. D.

ETT LITET BIDRAG TILL SIBIRIENS CHLOROPHYLLOPHYCE-FLORA. —Af. O. Borge. Reprint.

ANNUAL REPORT OF THE POSTMASTER GENERAL OF THE U. S., 1890.

BULLETIN NO. 12, EXPERIMENT STATION OF FLORIDA. Tobacco.

REPORT OF THE NATIONAL ACADEMY OF SCIENCES for 1888.

DEFORMED DIATOMS.—J. D. Cox, LL.D. Reprint.

CATALOGUE OF THE MICHIGAN MINING SCHOOL. — Houghton, Mich., 1890–91.

REPORT OF THE SECRETARY OF AGRICULTURE, 1891.

TRICHINA SPIRALIS.—Dr. H. M. Whelpley.

EDITOR THE MICROSCOPE: —

In the December number of your publication, I notice a queer criticism to an essay of mine in last January number of *Literary Light* of this city of Minneapolis. In that essay I stated that all the sciences had their basis as a starting-point, explained to be an assumption, i. e. an hypothesis, a myth, an hallucination.

Please be kind enough to place an assumption, hypothesis, or a myth, under the focus of your microscope, and see if you can discover as much as a speck of reality in them, or can make one out of them; please inform us of the process by which such things can be magnified into facts. Please examine a reproduction, my starting-point for all sciences (not necessarily with your glass); you may perceive it, and the active cause of it, to be an absolute fact—a self-integrating laboratory in full operation, generating and producing phenomena, in deathly silence.

The point in science I desire to make, and to be understood, is: That all the determinate elements called matter, or phenomena, are only effects of causes, and of themselves, there are no causes, power or activities in them.

Causes are the active indeterminate elements (which I prefer to call them, as they are sometimes spoken of by scientific scholars) composing the universe. All powers reside in them and them only. A definite amount of their powers and energy, resides, permeates and pervades all determinate matter, causing activities to be manifested in them.

Phenomena are facts. What may be said about them won't alter them. My explanations, which you are pleased to call "indescribable twaddle," has nothing whatever to do with Nature's facts, or laws, or powers by which they are evolved.

Please show the fallacy of this doctrine.

Yours &c. in the cause of science,

MINNEAPOLIS, Minn. GEORGE DAVIS.

EDITOR THE MICROSCOPE:—

From reading the extract from the *New York Medical Journal* in the December number of THE MICROSCOPE, it occurs to me that it may be of interest to record the fact that the trout of the Adirondack region of New York are more or less infected with intestinal worms (*not angle worms*). I have by me as I write, a specimen taken from a large trout at Albany Lake, Hamilton county, in July, 1877. The worm was alive and sprightly at the time of capture, and was found in the intestine below the stomach. Respectfully,

BUFFALO, N. Y. HERBERT M. HILL, Ph. D.

ITEMS

The German government is steadily on the lookout to increase the chances of scientific research. Heligoland, the latest peaceful conquest of Germany, will be made a chief station for biological investigation. This is all the more to be welcomed, as England, the prior mistress of Heligoland, has in no way utilized the favorable location of the island for the study of sea-life. This is the first German zoölogical station maintained by the government, for the station of Professor Dohrn, at Naples, is a private one, and is merely subsidized by the Prussian State.—*Therapeutic Gazette.*

Dr. Charles M. Cresson, of Philadelphia, states that he has re than once found the typhoid bacilli in the juice that he has ezed from celery grown near Philadelphia.—*Annals of ne.*

THE MICROSCOPE

AN ILLUSTRATED MONTHLY MAGAZINE.

VOL. XII. TRENTON, N. J., FEBRUARY, 1892. No. 2.

ORIGINAL COMMUNICATIONS

THE ESOTERIC BEAUTY AND UTILITY OF THE MICROSCOPE.—II.*

BLOOD DISEASES, SUCH AS LEUCOCYTHÆMIA, MALARIA, ERYSIPELAS, BOILS, CARBUNCLES.

EPHRAIM CUTTER, M. D., LL. D.

THESE I cannot understand without the use of the microscope. Asthma and Hay Fever I find are explained by *Morph. B.* They are essentially a gravel of the lungs and nares. Epidemic influenza or infusorial catarrh is made to me a practical business matter by the use of the microscope. Bright's disease of the kidneys cannot be made out unless *Morph. E.* shows the casts of the kidney tubes and fatty epithelium, besides the macroscopic albumin. Neurasthenia in men is satisfactorily explained by the use of the microscope, showing catarrhal discharges in one of three forms: 1, Protoplasmic; 2, Skeins; 3, Indian-club shaped. Sometimes these forms are mingled together. A one-inch objective is the best for this determination.

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Diagnosis of cancer.—Diagnosis of healthy milk used as food. This is not easy.—Trichinous muscular tissues.—Eggs of intestinal worms in fæces.—Parasites, as itch insects, harvest mites, etc.—Diagnosis of ovarian cysts from fibro-cysts.—I find the morphology of the fæces gives indispensable information as to the food the patient has eaten; the character of his digestion, the amount of intestinal fermentation, the ability of the organs of digestion to do their work; shows the presence of tape and other worms, and is, with polarized light, a source of some of the finest microscopical exhibitions. This making the most repulsive and disagreeable objects in Nature æsthetically agreeable and attractive, certainly shows great transforming powers in the microscope. Reference is here made to the beautiful dissections of vegetable tissues found in the fæces. The same remark applies to the morphology of the sputum in a limited measure. Beauty is found in the ruins of the lungs.

The morphology of the air, which surgeons should study, has been very instructive to me. Malaria in *Morph. B.* (or bad air) has been a clear subject since this has been studied.

Morphology of dirt as found in and on the human body I have found very instructive in my business. Prof. Reinsch discovered vegetation on the surface of the coins used as money, and I have found the same in the dirt under the finger nails of my own hands. The late lamented Dr. Louis Elsberg coöperated in this study.

Morphology of hydrant drinking waters.—Having studied the morphology of the hydrant water of over thirty cities and towns, I was called in court as an expert on a water privilege case. I was able to prove that the water was taken from the miller's supply, which had been denied. I am glad to know that the Massachusetts State Board of Health is paying attention to this subject of so great sanitary importance.

Morphology of food I find is a most interesting subject. It shows the changes produced by the various operations of cooking, which is connected with things which are supposed to be thoroughly understood because they come so closely in contact with the human body constantly ever since man came into the Foods are easily had, and easy to examine. Polarization well the food is cooked, as starch and red muscular polarize light when cooked, and of course when

partly cooked, partly polarize light. Potatoes, beans, leavened and unleavened bread, crackers, dough, etc., are fine objects to study. There is no doubt that a great deal of sickness comes from imperfectly cooked food. I find the microscope an excellent means to tell what foods are bad for my patients, by studying the *Morphologies A, D, E.* Strawberries, for example, are poor food. This is a large, new and interesting field of study. I hope microscopists will cultivate this field more and bring out as good results as Dr. Taylor of the U. S. Agricultural Department has done with butters, true and false.

Morphologies of invalids' and infants' food, cereals especially.—This division comes almost under the heading of adulteration of foods so little do the advertised statements as to their character come up to their own demands. They are not adulterated, but wrongly described. I have tried to protect invalids and infants, with little success so far as I can learn. The microscopists who have this class of individuals in their families cannot afford not to examine their food, and protect the helpless ones from harm if not imposition. Of course this morphological examination should be supplemented by the chemical and physiological examinations. All have a right to examine their food as far as possible macroscopically, but the microscopical examination will acquaint the inquirer with the facts very much more satisfactorily.

Morphology of adulteration in foods is a large one and has been made the subject of a volume by Hassall. There is great need that this examination be kept up, as these admixtures are so common everywhere. When microscopy becomes as common as music and is used as much, then the queens of our parlors will vie with the queens of our kitchens in securing pure, not "strictly," "absolutely" and fully "warranted" pure foods.

Morphology of drugs in powders, extracts, substance, crystals, oils, etc.—I have not cultivated this department as much as I would like to, but I see here a large field for the use of the microscope as a means to the end of uniform and genuine preparations.

Morphology of wearing apparel.—I have found the use of the microscope to be of much avail in selecting silk patterns for dresses and clothing for my family. The time is coming when

the microscope will detect the germs of diseases in infected clothing. It has come.

Some years ago the ladies of Boston held a fair to buy the old South church. A party in charge of one department perpetrated some frauds and erased as far as possible by friction the lead penciled items entered in the department memorandum book. I was able by low powers to reproduce nearly all the erasures, much to the delight of the ladies.

This syllabus, though incomplete, is enough to show that the demand of microscopy in pleasure and business is one that commands the respect of thoughtful minds, and should be extended to embrace thousands where it does now one individual, for it is an instrument of precision capable of great good to all.

(*To be continued.*)

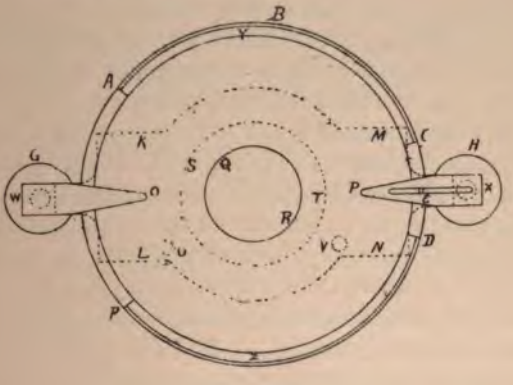
A MODIFICATION OF THE BAUSCH & LOMB GLASS STAGE AND OBJECT CARRIER.

W. F. DURAND, PH. D.

THE device represented in the accompanying sketch is a modification of the glass stage and slide carrier made by the Bausch & Lomb Optical Co. In the regular form, as in nearly all similar carriers, both hands are needed to manipulate the slide comfortably. It does not seem necessary to dwell at length upon the desirability of a simple carrier which shall place the slide under the complete control of one hand, that is, as complete as any carrier other than a mechanical stage can furnish. The luxury of being able to control definitely and easily the movement of the slide with one hand, while the other is free to remain constantly on the fine adjustment, is surely one that no worker would willingly forego after having once experienced it.

[illegible] as to this end that the simple modifications represented [illegible]duced. To those familiar with the regular form of [illegible]ch will need little explanation. To others, how[illegible]d description may be necessary.

In the sketch the stage and carrier are supposed to be viewed from below looking upward.



The device consists of a glass plate held in a brass ring A B C D F, which slips over the regular brass stage, bringing the glass plate down nearly into contact with it. A certain amount of clearance between the two for the working of the metal clips W O and P X is secured by the brass stage bringing up on the ledge Y Z of the metal ring, thus keeping the glass about one-sixteenth of an inch from the brass stage. The brass ring is cut away down nearly to a level with the glass at two places, A F and C D. On top of the glass plate (underneath in the drawing) is a metal plate about one-twentieth of an inch thick, shown in dotted lines K M N L, with a hole, S T, one and one-half inches in diameter. At the two ends this plate projects to W and X, where two finger-buttons are attached. Here also are attached two bent clips, O W and P X, which come down under the glass plates (on top in the drawing) and rest on it at O and P. At E a small steel pin, about one thirty-second inch in diameter, is set into the brass ring. In P X is a slot in which this pin neatly works. The pieces O W and P X are so bent and curved that they hold, with the action of a spring, the metal plate into contact with the glass. The plate has cemented to it at K L M N bits of chamois skin and small pieces of the same are placed under the points P and O. The actual contact is thus between the glass stage and these pieces of chamois,

and the motion is exceedingly smooth and pleasant. At U and V are two posts to which spring clips for holding the slide are attached. They may, if desired, be turned down at the side out of the way, in which position the writer almost invariably has them. The plate is manipulated entirely by the button G G. The other might be omitted, but as it was on the original stage, it was allowed for symmetry to remain. The pin E provides what amounts to an adjustable centre, about which the metal plate may move, and it will be found that any desired movement is perfectly definite and certain, and that one hand is entirely free to remain constantly on the fine adjustment.

The difference between this and the form as regularly built by the Bausch & Lomb Co. involves simply the pin E and corresponding slot, with the consequent necessity for a larger hole, S T, and the cut away portion, A F. The pieces of chamois referred to provides also, in the writer's opinion, a much smoother movement than the metal points on the regular form.

WALTER H. BULLOCH.

HENRY L. TOLMAN,

PRESIDENT OF THE ILLINOIS STATE MICROSCOPICAL SOCIETY.

THE death of Walter H. Bulloch, of Chicago, the eminent microscope maker, is a severe loss, not only to the Illinois State Microscopical Society, of which he was for nearly twenty years a prominent member, but to the cause of science at large, and a short sketch of his life and work should not be uninteresting.

Mr. Bulloch was born in 1835, at Glasgow, Scotland, and lived there until he was seventeen years of age. About 1852 the family emigrated to New York, where Walter learned the trade tailor with his father. But his innate fondness for mechan- pursuits made him dissatisfied with his prospects, and he apprenticed to Messrs. Pike & Sons, then a leading firm ticians and instrument makers in New York city. After his time, he went into business on his own account until of the rebellion, when he enlisted as a private in the N. Y. Volunteers. His term of service, however, was

very short, as he contracted a severe cold, which developed into rheumatism, incapacitating him from further work, so that he was mustered out of service. Returning to New York he formed a partnership with William Wales, and continued in business there until 1866, when he moved to Chicago. He was very successful, and had accumulated considerable means, when his shop and tools were destroyed in the memorable Chicago fire of Oct. 8–9, 1871, and Mr. Bulloch sustained a financial loss from which he never recovered. Immediately after this misfortune he went to Boston, and was for a time connected with the late R. B. Tolles, but soon returned to Chicago. In 1888 he accepted a position in the Bureau of Weights and Measures under the Government, but he chafed under the restraints of an official situation, and after six months' experience, returned to his home in Chicago. Before he left, his health had begun to fail, and after his return late in the Fall of 1890, he suffered still more. But his indomitable perseverance led him to struggle on. He opened a place at No. 303 Dearborn street, in a very advantageous business portion of the city, and began work again. It was not for long. After struggling with disease for almost six months, he was compelled to stop forever. He died Nov. 5, 1891.

Mr. Bulloch was a man of pronounced character and indomitable energy and perseverance. To those who did not know him well, he appeared brusque and overbearing, but his numerous friends soon learned to appreciate his straightforward manner of expressing his views, his pertinacious but just demands for a proper recognition of his rights, and his outspoken criticism of what he deemed erroneous in the theories or opinions of others. In his business he was conscientious and painstaking to a fault. Often when making an instrument or piece of apparatus to order, if he saw where there was room for improvement, he would spend hours or days in experiments, perhaps wasting the results of all his previous labor, refusing to slight his work at any cost. Whether it was the simplest accessory or the finest microscope-stand, nothing was allowed to leave his work-bench until it was as perfect as his trained hand and eye could make it. His reputation was more than money, and he lived to see his fame world-wide. Besides being a member of the Illinois State Microscopical Society, he was a member of the Chicago Academy

of Sciences, the American Society of Microscopists and of the Royal Microscopical Society of London. His death leaves a gap in the rank of scientific workers which can not easily be filled.

METHOD OF PREPARING AND MOUNTING MINERAL SECTIONS FOR STUDY UNDER THE MICROSCOPE.

FRED. B. KILMER.

THE method of preparing and mounting sections of minerals and rocks for microscopical work was recently illustrated by Prof. Frank L. Nason, at a meeting of the New Jersey Microscopical Society. It is the method as used in the laboratory of the New Jersey State Geological Survey, and contains many things of interest to all microscopists; and the methods can be adapted to the demands of any who may desire to mount such substances.

The mounting of sections of rocks and minerals, though somewhat tedious, does not contain any difficulties that may not be surmounted by the amateur, and a section once mounted is certainly something worth having for its beauty, when viewed by plain, transmitted light, or under the polarizer.

Then it is hardly possible, under modern methods, to gain a clear idea of rock and mineral structure in any other way.

In the survey work just mentioned, the field geologist selects the specimens that may seem of interest and opposite a number in his note-book carefully describes the surroundings and everything that may be of service in the study of the specimen. A piece somewhat larger than a hen's egg is put in a strong manilla envelope, bearing the note-book number, to be sent to the Station. As the collector may not see his specimen again for months, perhaps never, we perceive the value of his field notes and numbering. His records either accompany or follow the specimen and serve as the basis of all knowledge and history connected with the specimen.

Arrived at the laboratory, it is taken from the envelope and
number printed on it. A heavy glass slip is marked with
me number with a diamond, and a piece is chipped off,
longitudinally, to obtain a section across the layers of
ure.

This may be better understood if we say that under a pocket-lens a piece of rock or mineral lies in strata or layers. Now imagine these layers to be leaves of a book; a leaf from the book is not to be removed for a section, as every other leaf may be different, and the whole will not be represented, but cut down the edge of the book and you have a shaving from every leaf, which is what is needed in rock sections. This clip is then (in company with its numbered glass) to be ground perfectly flat and smooth. This is accomplished on an emery-wheel followed by buffers of emery and rough cloth, until as high a polish as possible is given it. Very good work may be done with an ordinary grind-stone, followed by cloths saturated with oil, and coarse and fine grades of emery, finishing with a rouge cloth.

The ground surface should be, as nearly as possible, flat. This surface is cemented to the numbered heavy glass slip with a cement prepared by melting together over a gentle heat 16 parts of thick Canada balsam and 5.50 parts gum shellac. The attached clip is then to be ground thin, either by first sawing as thin as possible with a diamoud saw (if one has no diamond saw, it may be worked down with files varying from coarse to fine, then grinding on a stone), finally grinding with emery. The emery can be made uniformly fine by rubbing between two plates of glass or metal, or by floating in a jar of water, collecting the sediment as one grade and the floating particles on filter-paper as another. The section is ground until printed matter can easily be read through it. In doing this work by hand in a small way it will be found that one stone will often grind another, and that a razor-hone and strop serve as good polishers.

A regular microscope slide is then numbered correspondingly to the section, a drop of thick balsam put on it and heated to expel the turpentine, until it is as hard as molasses candy. The thick plate holding the ground section is then heated until the latter will move easily. It is then removed with a thin knife to the slide. The latter is gently heated, but the balsam is not allowed to boil. While heated the section is covered with a little balsam, the cover glass is heated and dropped on the still warm slide in the usual manner. It should be allowed to settle by its own weight, as in this manner the air bubbles are expelled without drawing off too much of the mounting medium.

When the slide is cooled off, clean away the excess of balsam with alcohol or benzol, and finish to suit the taste or to correspond with other cabinet slides.

Meteoric rocks, granites, gold, silver and copper specimens, in fact any mineral, can be made into a beautiful and valuable slide for study in this way.

BOTANICAL DISSECTING MICROSCOPE.

J. ZENTMAYER.

The instrument was designed and constructed to meet the requirements of Prof. J. T. Rothrock, of the University of Pennsylvania, in his botanical class. It is made of polished brass,

and consists of a circular base five inches in diameter, to which is fastened a stout pillar which carries the broad stage (four by five inches), provided with spring clips, which can be removed

and a glass plate one and three-quarter inches in diameter fitted to the well of the stage. The jointed arm carrying the lenses is moved by a sliding rod, giving fine and accurate movement. The stand has plane mirror with complete adjustments, two single lenses of one inch and three-quarter inch focus, which may be combined to form a two-third inch, the whole instrument being packed in a neat walnut case, with drawer and handle.

ELEMENTARY MICROSOPICAL MOUNTING.—IV.

DR. A. M. WEBSTER.

SHELLAC CEMENT.

WITHOUT exception this is the best, the most convenient, the easiest to make and to keep, and the most satisfactory and trustworthy cement that the microscopist can use. It may be made by any one, and used successfully by the least skillful, without much worry as to the result. It is an indispensible article to the microscopist. With it he may build up cells, fasten on cover glasses, attach deep tin rings to the slip, patch up old mounts, and use it as a kind of universal panacea for preparations microscopical. Its tendency toward that dreaded characteristic of some other cements, running under the cover, is so slight that it may be almost disregarded, unless, of course, the cement be used too thin, or unless the user be careless. Every cement will run under, if allowed to do so; the laws of capillary attraction are never suspended; the microscopist must act so as to prevent them from doing his slides an injury. With shellac he has little to fear with ordinary caution.

The cement is simply shellac dissolved in alcohol. Put the gum in a wide mouthed bottle, fill it with alcohol, and leave it to dissolve. If the solution is too thick add alcohol till it is properly thinned; if too thin, leave the cork out, with the bottle in a dust-free air, and evaporation will do the rest. It should be thin enough to flow freely from the brush and to remain on the glass where the brush leaves it, without running in an irregular way over the surface, as it will run if too thin. When dry it makes a yellowish brown ring that is not unpleasing, but which may be colored by adding a little of any of the anilines dissolved in alcohol. These coloring matters, however, are

rather more manageable if added to the cement as made from the bleached shellac.

This purified or bleached variety dissolves very slowly, and the solution is likely to present a curdled appearance due, it is said, to a change produced in the shellac by the absorption of water. A good solution already made, may be purchased from the paint and hardware shops, and evaporated to the desired consistency. This makes an excellent colorless and transparent ring, but no better than that formed from the common unbleached gum. The latter, however, is always turbid, and therefore, less attractive to the æsthetic eye. To prepare a clear solution the following method has been recommended by Prof. W. H. Seaman. I have not tried it.

To the alcoholic solution is added about one-fourth of its volume of naphtha or of gasoline, and the mixture is shaken several times violently, at intervals of two of three minutes. Let the bottle stand undisturbed for several hours, when the naphtha will be found in a layer at the top with all the insoluble flocculent matters, and the clear alcoholic solution will be beneath. The former should be carefully poured off and discarded, or the lower layer may be removed by a siphon. It is this lower layer which is wanted, and it should be evaporated to such a consistency that it will flow easily and smoothly from the brush. The addition of a little castor oil will make it rather more smoothly flowing.

Personally I am not in the habit of making this cement according to measurement and to rule, except the rule of thumb. I add alcohol to as much shellac as is convenient and leave it to dissolve, diluting or evaporating it as necessity demands. This is not a commendable way. It is better to follow some regular method. The following are the proper proportions:

Shellac, 60 grammes; alcohol, 60 grammes; castor oil, 25 grammes; alcoholic solution of any aniline dye, a few drops. Dissolve the shellac in the alcohol, add a little of the coloring if desired, and for every 60 grammes of the solution add 25 grammes of castor oil. It is recommended that the mixture be heated until the desired consistency is obtained, but heating alcohol is rather dangerous, and should be done with great caution. Spontaneous evaporation will answer the purpose as well. It is said that the shellac will become more soluble if treated

with ether before the alcohol is used. The broken gum should be soaked in the ether in a closely-stoppered bottle, until sufficiently swelled, when the excess is poured off, the alcohol added and the solution treated as already described.

Although this cement dries rapidly and will cling tenaciously to the glass, it may be forced to adhere more closely and to dry more quickly, by holding the freshly made cell over the lamp flame. This should be done until the cement will be hard as bone when cold, but so carefully that it shall not boil. In that case the ring will be spoiled, as the bubbles will be permanently entangled, and the surface made uneven and irregular by them. When cold, the ring will be so closely adherent to the glass that a knife and some labor will be neccssary to remove it. Cells made in this way are admirable for preparations of any kind, even for balsam mounts, that may then be finished with a ring of balsam dissolved in chloroform. The reader of course understands that only the empty cell should be heated, not the mount after the shellac has been applied to the cover glass.

KING'S CEMENTS.

These are a series of cements made by the Rev. J. D. King, of Cottage City, Mass. Their composition is a secret. Those that have used them recommend them, with much praise for their good qualities. They are beautiful when applied to the mount, as they are perfectly transparent and delicately colored. If the reader should prefer to buy these he will not be disappointed in the result, and they are not expensive. Shellac is probably their chief constituent.

WHITE ZINC CEMENT.

Let me introduce what I have to say about white zinc cement by the statement that personally I have never used it. All my experience with it has been my experience with it as used by others, and I early became prejudiced against it. With it my microscopical life has been a sad one. The material is much in vogue for making cells and for finishing mounts, but I want to warn the reader against it. I have found it the most dangerous and the most treacherous thing that the microcopist can employ. My experience and my observation of its action are, as I have said, confined to slides received in exchange or bought from one

of our leading preparers, who uses and recommends it. Yet every slide that I have had from him finished with white zinc cement has been ruined and, in most cases, the object has been lost. In one or two instances I have been able to save the object, but in every case the cell has betrayed the maker's confidence.

For some time, it may be for several years, the cell is trustworthy, then it suddenly begins to deteriorate in one of two ways. The cement, after being for a long period apparently dry and permanent, will begin to creep under the cover, and will continue to advance with a slow but irresistable movement, until the preparation is ruined. A slide in my cabinet at this writing was mounted in glycerine three years ago, and, until within three months, was apparently as sound as could be desired, yet within those three months one-third of the cell has become obscured by the slow encroachment of the deceitful white zinc cement.

Another equally treacherous method of showing its unscrupulous character is by deliberately leaving the glass, carrying cover and object with it, and doing it in so slow and guarded a way that the microscopist learns of it only when too late. This is its custom when it does not conclude to run under the cover after it has been trusted for years. Without a single exception, every white zinc cell that I have ever had, up to the time of this writing, has been ruined in one or the other of these ways. I now possess four. One is being spoiled by the slow entrance of the cement into the cell; and three cells are gradually loosening themselves from the slip, a method that seems to be a favorite one. The result will be that before long the slide will receive a slight jar, when the cell, the cover and the object will together leap into the atmosphere, and I shall probably have the satisfaction of seeing them lying on the table, glycerine side down, of course.

The trouble has been extensively discussed in the journals, and it is said to be due to improper methods of manufacture. This may be, but it is then my misfortune never to have seen any that was properly made.

Dr. Frank L. James, an accomplished and expert microscopist, states that the difficulty, by many so bitterly complained of, is due to incorrect methods of manufacture. He says that

he has used the cement for many years, and having made it himself with great care and attention to the details, he has had with it perfect success, and has every confidence in it. I have never seen any of Dr. James' mounts, made with his own white zinc cement, but I accept his statements as coming from one having authority, and the reader, if he can obtain the cement, as made by Dr. James, may, I am sure, use it with every confidence. The trouble seems to be that Dr. James' cement is not in the market; that used and for sale by the dealers is as abominable as anything can be imagined to be.

The cement is commonly made by dissolving pulverized gum dammar and gum mastic in benzol; to this solution is carefully added the white zinc (zinc oxide), rubbing it long and faithfully in a mortar. It is then filtered. Dr. James, writing about the proper method, says:

Three points are absolutely essential to success in manufacturing a good article of the oxide of zinc cement: good materials, time and patience. The zinc white must be white, not yellow, and must be thoroughly free from moisture; the dammar free from dirt, and the benzol of the first quality. The solution of dammar in benzol should be thin enough to admit of filtering it through absorbent cotton or mineral wool, though if the gum be carefully picked it will be sufficient to run it through two thicknesses of an old Japanese or Chinese silk handkerchief. A prime essential to success is to rub up but a little of the zinc and dammar at a time. Not over a dram of each should be put into the mortar together, and trituration should be continued till all grittiness disappears. The author formerly filtered the finished product through silk or linen, but the task was tedious and the waste large. He now simply agitates the product, and sets it aside for twenty-four hours. At the end of this time he decants the supernatant portion and returns the sediment to the mortar, again triturates with a fresh portion of the dammar solution, and repeats the operation of decanting, etc., until a perfectly smooth, homogeneous cement is obtained. If, in the end, after allowing the cement to stand in a perfectly quiet place until separation occurs (this will take at least six weeks, if the cement is thoroughly well made), it is found that the liquid is much in excess of the solid portion, the excess may be decanted and used for making more cement, or any other pur-

pose for which dammar solution is necessary. In rubbing up the residue of the first and second decantations, observe the same rules as to quantity treated each time as in making the original mixture.*

Dr. James seems not to use gum mastic as one of the ingredients. This, however, is included in all the formulæ for the cement as made and used by the dealers in Europe. Dr. James, in his "Microscopical Technology," again says in reference to this: "There is in my opinion no cement which can compare with it, either in the smoothness with which it flows from the pencil, rapidity of drying, tenacity and evenness of attachment, or the hardness and toughness of the product. In addition to these practical recommendations, there is nothing in the way of cements that is more beautiful in finish. In saying this much about the cement, I am quite aware that it has been decried and abused by certain parties, belonging to that class of workmen who invariably lay their own lack of skill upon the tools they use. I have used it constantly for fifteen years, and whenever it has failed to make a good and durable mount the failure could be traced directly to my own negligence or carelessness."

This is strong evidence in favor of the material, and I am glad that I have never even attempted to use it, preferring another kind that has rarely played me false. In condemning the white zinc cement I have not to blame myself for any lack of skill, nor for carelessness, as all my slides made with the material have been prepared by others.

But while writing this I have received a mount made by A. C. Cole, of London, a celebrated preparer. The slide is finished and the cell is made with white zinc cement. It is an interesting fact in connection with my criticisms, that this slide from this well-known preparer is acting as similar mounts always have acted and always will act. The cement is beginning to leave the glass. For at least one-half of the circumference of the cell the ring is separating spontaneously from the slip, and in time the separation will be complete.

BENZOL, BENZINE AND GASOLINE.

Benzol has already been mentioned several times and will be mentioned probably several times more, as it is an import men-

*Dr. F. L. James, in "The National Druggist."

struum for the microscopist's use. A common mistake among those who mount microscopic objects, especially at the beginning of their career, is to think that benzol and benzine are the same thing under slightly different names. They are entirely distinct, and benzine cannot be used in the place of benzol. Benzine is made from petroleum, while benzol is a product of the distillation of coal tar. In chemical composition they are said to be somewhat similar, but in action on the objects and on the mounting media that the microscopist uses they are as unlike as possible. The microscopist never has need of benzine. Gasoline, another petroleum product, can be advantageously employed for the cleaning of old slides that have been discarded, and the cleaning of the brushes that have been used in the cements and the mounting media. For these purposes gasoline is very convenient and useful, but for this only. Benzine might answer the same purpose, but I do not know that it has ever been tried. Gasoline, I know from personal experience, is an excellent cleaning agent.

REFERENCE TABLES FOR MICROSCOPICAL WORK.—V.

CARMINE AND HÆMATOXYLIN STAINS.

COMPILED BY PROFESSOR A. B. AUBERT.

ALUM CARMINE: carmine, 0.5 to 1 grm.; alum, 1 to 5 grms.; water, 100 grms. Boil 10 to 20 minutes and filter.

ALUM COCHINEAL: 1, cochineal, 1 grm.; 2, burnt alum, 1 grm.; 3, water, 100 grms.; 4, carbolic acid a drop or so.—1 and 2 to be rubbed up in a mortar; 3 is then added and boiled until about 50 c. c. remain; add a drop or two of 4 and filter. Nucleus stain.

ALCOHOLIC CARMINE: carmine, 0.6 grm.; ammonia, 2 grms.; glycerine, 60 grms; alcohol, 15 grms., water, 60 grms. Boil carmine with ammonia until dissolved, add the mixture of glycerine, alcohol and water; filter. It is well to keep the solution slightly alkaline by the occasional addition of a few drops of ammonia.

BORAX CARMINE: 1, carmine, 0.5 to 0.75 grms.; 2, borax, 4 grms.; 3, water, 100 grms.; 4, acetic acid, sufficient quantity.

Boil 1, 2 and 3 together, filter if necessary, add acetic acid so that the liquid from purplish becomes distinctly red; filter. Stains nucleus red, when sections are put into alcohol, 50 to 70 per cent., made acid with a little hydrochloric acid.

BORAX CARMINE: carmine, 1 part; borax, 4 parts; water, 56 parts, the three forming one volume; absolute alcohol 2 vols. For decalcified bone, etc.

BORACIC ACID CARMINE: carmine, 0.5 grm.; boracic acid, 4 grms.; water 100 grms.; or carmine, 0.25 grms.; boracic acid 2 grms.; concentrated solution of alum, 100 grms. Boil either mixture; filter while warm.

AMMONIA CARMINATE (dry): 1, carmine, 1 grm.; 2, ammonia, 1 to 2 c. c.; 3, water, 6 to 8 c. c.; 4, chloral; 5, strong alcohol.—1, 2 and 3 heated together until the ammonia has passed off; add 1 per cent. or 2 per cent. of chloral, then 4 to 6 vols, of strong alcohol; a precipitate forms which is washed with alcohol and allowed to dry. Keep in a well-corked bottle.

OXALIC ACID CARMINE: carmine, 1 part; ammonia, 1 part; water, 1 part, the three forming 1 volume; solution of oxalic acid, 1-22, 8 vols. Dissolve carmine in ammonia and water; add the acid and absolute alcohol, 12 vols. Stains rapidly. Clear the sections in alcohol containing a little oxalic acid.

HYDROCHLORIC ACID CARMINE: carmine, 4 grms.; alcohol 80 per cent., 100 c. c.; hydrochloric acid, 30 drops. Heat on water bath for one-half hour; filter while warm, and add a little ammonia and filter again. Clear sections in alcohol containing a few drops of hydrochloric acid.

HÆMATOXYLIN STAINS.

ALUM HÆMATOXYLIN: *A*, hæmatoxylin crystals, 1 grm., alcohol, 30 grms.; *B*, alum, 0.5 grm., water, 30 c. c. Drop *A*. into *B* until the color is deep violet; let it stand several days in an uncorked bottle exposed to the light; filter. Stains in 5 to 30 minutes; wash with water; overstaining reduced by soaking in alum solution for from 4 to 12 hours.

GLYCERINE HÆMATOXYLIN: hæmatoxylin, 2 grms.; glacial acetic acid, 10 c. c.; glycerine, 100 c. c.; absolute alcohol, 100 c. c.; water, 100 c. c.; alum in excess. Let the mixed solution stand exposed to the light for some time; filter; keep in well-corked bottle. Sections hardened in alcohol or potassium bi-

chromate stain in a few minutes; can be used to stain before sectioning.

GLYCERINE HÆMATOXYLIN: hæmatoxylin, 2 grms.; alum, 2 grms.; glycerine, 100 grms.; alcohol, 100 grms.; water, 100 grms. Stains rapidly; wash well with water. As a nucleus stain treat the sections with alcohol slightly acid with hydrochloric acid; wash all acid out after its action.

AQUEOUS HÆMATOXYLIN (Mitchell's): finely ground logwood, 2 ounces; potash alum, 9 drams; glycerine, 4 ounces; water, a sufficient quantity. Put the logwood in a large funnel with a filter; moisten the logwood and wash it with cold water until the water comes through nearly colorless. Dissolve the alum in 8 ounces of water; put a cork in the end of the funnel; pour the alum solution on the logwood in the funnel; macerate 48 hours; remove the cork, drain off the water, and wash the logwood with enough water to make the solution up to 12 ounces; add the glycerine, shake, filter. Put a few pieces of camphor or thymol in the solution. It will keep for a long time, and may be used diluted. Stains rapidly; diluted stains more slowly but perhaps more perfectly.

Sections stained with hæmatoxylin should be thoroughly freed from all acid before mounting.

Every reader is more or less familiar with the theory of the reticulation of the protoplasm within animal and vegetable cells. Those that accept the teaching state that the protoplasmic contents of the cells can be shown to be formed of interlacing threads, which together produce a network of great delicacy. As good objectives become the property of microscopists willing to do more than play in their leisure moments, the theory of the reticulation of protoplasm becomes less and less a theory and more and more a demonstrable fact, and

more and more widely accepted as one of the histological properties of the cell. In the entire domain of animal histology, there is hardly anything so interesting, and indeed so readily seen and demonstrated, as the reticulated structure of the protoplasm forming the red blood corpuscles of the vertebrates, especially of man himself. With the proper high power objective, every reader, medical or otherwise, with two hours of leisure time, can himself see this structure in his own blood and can show it to others.

All that is needed in addition to the proper objective is a solution of the bichromate of potassium. Writers on the subject speak of a fifty per cent. aqueous solution, a chemical absurdity because a chemical impossibility. The salt dissolves in the proportion of one part to ten of water; a ten per cent. solution is therefore the strongest that can be made. Even this, for the present purpose, is needlessly concentrated. A five per cent. solution is better, and this may be prepared by dissolving twenty-three grains of the potassium salt in a fluid-ounce of water. When filtered it is ready for use.

A glass slip without a cell should be used. Oil the margin of a thin cover-glass, to prevent evaporation, and on the slip place a small drop of the potassium bichromate solution. Prick the finger and touch the cover-glass to the blood. A small drop is needed, the smaller the better. Quickly invert the blood into the potassium solution and place the slide on the stage as speedily as possible. Although one's movements may be rapid, it is almost impossible to get ready to look through the microscope before alterations have begun to take place in the red corpuscles. And here the blood of the same person will act differently at different times. The red corpuscles will always become crenated, irregularly constricted and distorted, while the surface and the margins will be strangely knobbed. The soft substance will protrude into rounded, knob-like projections almost as soon as the potassium touches the corpuscle. In such cases the knobs are finally withdrawn and the surface again becomes smooth, the internal changes then appearing in a short time. On other occasions, with the same blood, the corpuscles will extrude rounded masses apparently connected with the globule by only the slightest tenure; the knob-like protrusions will elongate into delicate, often moniliform threads, or thickened

ribbons which resemble, somewhat remotely, the pseudopodic prolongations of the Rhizopods, although in action and in function there is not even a remote resemblance. These protrusions are usually abundantly developed, and the entire field may be filled with corpuscles in this condition. But the remarkable fact in connection with them is that they all are in motion. A protoplasmic thread from the surface of a corpuscle may be as long as the corpuscle is wide, while it may extend and twist and writhe and quiver like a living thing, and if the microscopist is looking at his own blood the sensation will probably be a new one, and not altogether agreeable, the little drops and the delicate threads trembling and shaking with an uncertain, irregular movement that is as fascinating as it is suggestive. The movements are not pseudopodic; they are not voluntary; they seem to be pedetic rather than otherwise, to be caused as the Brownian movements are caused, by thermal or electric currents. But in the corpuscles that show these kinds of protrusions and these kinds of movements, the reticulation of the protoplasm is seldom to be seen distinctly; in them it is seldom to be seen at all. Such corpuscles often become what have been called "ghosts," finally appearing in the field as colorless, empty rings, like the ghosts of corpuscles.

With those globules, however, whose knob-like protusions do not prolong themselves into motile beads or threads, the reticulation becomes beautifully and conspicuously visible within two hours, sometimes within half an hour, after the application of the potassium solution. The corpuscles grow gradually paler, the knobs are withdrawn, the surface becomes smooth and rounded, and the fine meshes of the protoplasmic net-work become gradually prominent, forming as pleasing and as instructive an object for the microscopist with an evening's leisure as can be imagined.

The meshes are exceedingly fine and the threads forming them exceedingly delicate, but at the points of intersection a thickening is produced that may be taken as so many guides whose position will direct one to the connecting threads.

With the proper objectives these appearances are readily observable. Yet, although the ease with which the reticulation may be seen is great, the statement should not lead the reader to think that the work is only a bit of child's play, and as easy.

If you can trace those delicate threads, see the little thickenings at each meeting point of those fine filaments, and perceive distinctly the minute dark spaces between the reticulations, you may be sure of four things of the greatest importance to the microscopist; you may be satisfied that the objective is good; that it is properly adjusted; that the illumination has been well manipulated, and that the observer's eye has been trained to a praiseworthy and enviable degree. The reticulation is easily seen and easily obtained; it is difficult to see and difficult to demonstrate. When the novice has made the experiment he will be able to reconcile these apparently contradictory assertions.

Ranvier, in his *Traite Technique d'Histologie*, says that this reticulum is an optical illusion, produced by the wrinkling of the surface of the globule. If this is true, then it is the most realistic illusion by which microscopist has ever been deceived. And if it is true, the unanimity of action by which those wrinkles assume the appearance of a net-work and manage to present the illusion of a minute thickening at the points of junction between each fibril, is certainly astonishing. But this beautiful structure within the red corpuscles, be it illusory or not, may be studied with a homogeneous one-twelfth inch objective or with a higher power, with a similar one-tenth and with a homogeneous one-eighth. A good one-fifth and a half-inch solid eye-piece will show it well, after the observer has learned what to look for. It is high power work; even the one-twelfth must be eye-pieced up to at least 1000 diameters; objectives of lower power than a one-twelfth must be super-excellent to bear the strain of such high power eye-piecing. If the light is made slightly oblique the effect will be improved and the reticulations will then stand out with delightful distinctness. The work is not difficult, yet it demands care and delicate manipulation, and it is worth every effort.

In connection with this structure there appears to have been a loss of opportunity, or perhaps it may be described by another word, since scientific men that have been present at recent executions of criminals by electricity have failed to examine the ed corpuscles for any changes in the net-work. At this dis- ice from the electrical chair it seems that a good chance is re presented to study the action of the fluid on this micro-

scopic structure. So far as I am aware nothing was done, nor even thought of, in connection with the reticulum in the red corpuscles of the first subject of electrical execution, and nothing has been done since then. Here would seem to be a good chance to learn whether or not there is any change in these parts of the corpuscles after the action of the electricity. That the reticulum exists there can be no doubt. That it is changed in form, appearance, number of reticulations, size of meshes, continuity of filaments, or in any other way, is a matter that should not have been neglected by medical microscopists, and should not be neglected when another murderer suffers the penalty. Any competent microscopist having access to the criminal before and after his death should make, before the application of the electrical current, a series of preparations of the corpuscles to show the reticulum, and another series as soon as possible after the heart has ceased to beat, and from a part of the body through which the fluid was known to have passed. Electricity may be readily applied to blood corpuscles on the stage of the microscope, but there the essential conditions are absent, and no microscopist cares to experiment with the currents used at Auburn. Such examination might not lead to an increase of knowledge, yet it might be of great value. Its interest, to say the least, would be great.

The reticulation is not restricted to the red corpuscles of man, but may be seen equally well in those of the lower vertebrates, and should form another splendid field of study for any one possessing the proper high power appliances. A preparation of alligator's blood, mounted by Prof. W. N. Beggs, of St. Louis, and some time ago kindly sent to me, shows the reticulum to perfection.

This little paper is only intended to call attention to the subject as one worth careful examination. Extended illustrated essays by Heitzmann, Klein, Elsberg and others are accessible in the microscopical and medical literature of recent times.

ACKNOWLEDGMENT.—To Dr. Wm. N. Beggs, St. Louis, for a slide of round-celled sarcoma of the ovary. This is a fine preparation of an interesting and important pathological change.

NEWS · FROM · THE · WORKERS ·

Dr. Radhael Blanchard, in the *Journal de Micrographie*, says that of the fungi parasitic on man, there are only four whose direct transmission to us from the animals with which we are commonly connected can be demonstrated. These are *Achorion Arloingi*, Busquet, 1871; *Achorion Schœnleini*, Remak, 1845; *Trichophyton depilans*, Megnin, 1878; *Trichophyton tonsurans*, Malmsten, 1848. Direct contagion from animals to man is very probable but not proved, for these four: *Actinomyces bovis*, Harz, 1877; *Microsporan Audouini*, Gruby, 1843; *Lepocolla repens*, Eklund, 1883; *Aspergillus fumigatus*, Fresenius.

MICROSCOPIC ANATOMY OF THE HUMAN HEART.—Dr. A. V. Meigs* says the return vessels in the substance of the heart, except a few of the larger size, have thin walls and a structure identical with that of the most minute capillaries. In this respect they present a strong contrast with the arterioles, as the latter, even when of very small size, are similar in structure with large arteries, both having three coats. At points where these return vessels are formed by the coming together of minute capillaries, the number going to form the return vessel is very much greater than at corresponding positions where arterioles (supply vessels) break up, and the angles formed are much less acute, right angles even being formed at such junctions of the venous vessel.

The observation of the presence of spaces in the fibres of normal human heart-muscle is likely to prove of great importance, if the explanation that they are capillaries is correct. The fact ıat endothelial nuclei can be seen at the edges of such spaces in ›st all properly prepared sections, and that occasionally even hole circle of the endothelial wall is visible, would seem conclusive evidence of the correctness of this explanation.

Jour. Med. Sciences.

PLASMODIUM OF MALARIA.*—The best results are attained in searching for the plasmodia by examining fresh, unstained preparations with an immersion lens at the bedside of the patient. If the blood cannot be examined in this way, cover-glass specimens can be made and stained with concentrated methyl-blue or malachite-green. Prepared in this manner, the plasmodia are stained pale blue or greenish, and stand out sharply.

They cannot be confounded with anything else, whether they are inclosed in a blood corpuscle or free in the plasma.

Prof. Heneage Gibbes, in the *Transactions of the Michigan State Medical Society*, says that he concludes, by reason of his observations and experiments, that Phthisis and bovine tuberculosis are distinct diseases in their causation, although the result is the same, viz: destruction of the lung substance; and that the tubercle bacillus is not yet proved to have any causal relation to either, but would seem to be a concomitant of the process of caseation.

The tubercle bacillus is characterized by its relation to certain staining processes. But it is not alone distinguished by this. The bacillus of leprosy has the same power, as well as some others, and some forms of micrococci. An investigation by some German observers has also brought to light the fact that any ordinary bacillus, when cultivated in sterilized material to which twenty per cent. of fatty matter had been added, acquired the characteristic reaction of the tubercle bacillus. Professor Gibbes has no animus against this bacillus. He simply contends that its status in society is not yet determined.

WAYS AND MEANS

AN INEXPENSIVE MICROTOME, BY PROF. E. B. KNERR.—Quite an efficient, yet very inexpensive microtome, may be made as follows: Two pieces of hard pine, $\frac{3}{4}$x3x18 inches, are planed

*Berliner klin. Wochenschrift.

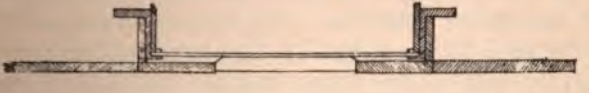
perfectly smooth, clamped together and two $\frac{3}{8}$-inch holes bored midway between the sides, $1\frac{1}{6}$ inches respectively from one of the ends. Two other pieces, $\frac{3}{4}$x$1\frac{3}{8}$x12 inches, are also made perfectly smooth. A strip of felt or cloth, 3 inches wide and 12 inches long, is glued to a face of each of these four strips of wood, passing the cloth around and fastening to the edges in the case, of the two narrow strips. This done, the four pieces are screwed together lengthwise in such a way that they will form a square well, and be flush at the end opposite to that having the holes in the longer pieces. In this way we have formed a felt-lined, square well, about $1\frac{1}{2}$ inches on a side and 12 inches deep. A square piece of wood, about $1\frac{1}{2}$ inches on a side and 11 inches long, is made perfectly smooth and fitted into this well, so that it may move vertically with slight friction against the felt-lined walls. Into the end of this square piece a hole, about $\frac{7}{8}$ inch in diameter and $1\frac{1}{2}$ inches deep, is bored in the direction of the axis, into which the roll of paraffin containing the object to be sectioned, may be firmly wedged by means of crescent-shaped wedges. Two glass slips, such as are used for mounts, are now glued parallel to each other across the ends of the 3-inch pieces in such a way as to allow the paraffin roll to rise between them.

Now, turning to the other end, two round pins are fitted to pass through the holes bored in the 3-inch strips, and about these is rolled a long ribbon of stout manilla paper, $1\frac{3}{8}$ inches wide and from 10 to 12 feet long. Most of the paper is first rolled on the lower pin, and then the free end is fastened to the upper pin and several turns made. The central shaft of wood bearing the paraffin roll in its upper end, is now pushed down in the well until its lower end bears upon the upper roll of paper. The paraffin roll is adjusted and trimmed so that its upper end is on a level with the surface of the glass slips. As the paper is now unrolled from the lower pin and rolled upon the upper, the latter roll, by its increasing diameter, pushes the central shaft upward, and sections of any desired thickness, or thinness, may be made by passing a stout razor over the glass slips. One complete turn of the upper pin, of course, raises the shaft just the thickness of the paper, and any fraction of a turn raises it just that fraction of the thickness of the paper. The machine should be clamped to the work-table.

PRZEWASKI'S METHOD OF IMBEDDING IN PARAFFIN.*—Dehydration in absolute alcohol may be avoided by the use of the following method, which is cheaper, surer and applicable to larger masses: The piece is transferred from ordinary alcohol to anhydrous aniline oil, or oil containing but little water, and is to remain there for 24 hours. It is then transferred to chloroform, which penetrates it and dissolves out the aniline oil. After a sojourn here of 24 hours it is placed in a solution of paraffin in chloroform (40 per cent), then in melted paraffin, which should be hardened immediately so that the tissue shall not become brittle.

Aniline oil may be dehydrated by distillation or by placing in it a small piece of caustic potassa. The oil gives the specimen a yellowish amber, translucent appearance, which disappears as the chloroform enters. This method has the additional advantage of allowing the use of specimens not entirely dehydrated, the chloroform taking the water when it is mixed with aniline oil. The preparation is finished in the usual way.

AN IMPROVED LIVE-BOX.†—It is frequently desirable to examine an object with a high power after it has been found with a low one, and we all know how very fond living creatures are of getting to the edge of the drop of water in which they are placed, and to shift them to the centre is frequently a tedious work, and is often fatal to the animal. To remedy this defect



I have had a live-box constructed, in which the glass tablet is somewhat reduced in diameter, but the outer ring is enlarged sufficiently to allow any high power to focus to the very edge of the glass tablet, and the result is very satisfactory. An object lying anywhere in the live-box can be reached by the condenser from below, and by both high and low powers from above; besides which it acts as a very good compresser, capable of fixing, without hurting, the smallest Rotifers, and when you know

*Centralb. f. Allg. Pathol. u. Pathol. Anat.—Cf. Bul. Belge Mic.

†Jour. Q. M. C.

how to do it, it is also possible to get a Rotifer in so small a drop of water that it is unable to swim out of the field of a quarter-inch objective. I have had it in constant use for animals of all sizes, from the smallest infusoria to tadpoles, and I hope it will be found equally useful to my fellow pond hunters.

C. ROUSSELET.

NEW PUBLICATIONS

AN ELEMENTARY HANDBOOK ON POTABLE WATER, by Floyd Davis, Ph. D. 12mo., pp. 118. Boston: Silver, Burdett & Co. Price, $1.00. Prof. Davis is evidently an expert in the chemical and hygienic portions of the subject he has selected for popular treatment in this excellent little book, but on certain points he as evidently feels his incompetency and touches them lightly, yet he fails to escape some incorrect statements and some bad teaching. While these blunders mar the fair surface of the commendable little work, they should have been eliminated, since the book will be accepted as authoritative, these little errors and all. The chapters treat of pure water, inorganic constituents, vegetable constituents, micro-organisms, water supplies, natural purification, artificial purification, systems for central filtration, with an interesting appendix. The section on central filtration should be read by every board of water commissioners in the country, for it is at the filters that the majority of our water supplies may be vastly improved.

But while Prof. Davis' book will be acceptable to every intelligent reader, and a source of valuable information to the majority of laymen, it contains some statements which are not only erroneous, but laughable. Speaking of the animal constituents of water he says (page 34): "*Leeches,* in this connection, are mere curiosities, still they are sometimes accidentally swallowed in potable water. They are liable to attach themselves on the **rynx,** and when once fixed they seldom fall off spontaneously. **ing, nausea** and spitting of blood are produced by them,

and repeated bleeding from the larynx produces anæmia." Before anæmia could be produced by bleeding from the larynx it is likely that something less agreeable would be suffered, but how even a leech in the pharnyx could produce hemorrhage from the larynx is not explained. On page 25, speaking of *Algæ* as vegetable constituents of water, he says: "Thus the *Flagillata* (*sic*) are generally found in water containing decaying infusions of vegetable and animal matter, and they have been detected in the dejections of cholera and typhoid fever patients." This assertion conveys a wrong impression, and is at best open to question. "*Cladophora* and *Vaucheria* are generally found only in saline waters, and it is doubtful if the marine forms of these *Algæ* can live in water containing no sodium chloride." About the truth of the last phrase there is not a particle of doubt, while there is much in connection with the first. On page 32 the author makes the astonishing assertion that "All true *Infusoria* are covered with cilia, by means of which they glide through the water." Of the three great classes of *Infusoria* the members of but one are ciliated.

But while the author is weak in his microscopical accomplishments, and while the misstatements are not numerous and may be considered as only minor blemishes, the book is to be commended to the class of readers for which it is designed. It contains much vital matter which should be familiar to every enlightened man. The presence of an index and the absence of the advertisement from the back of the page of contents would have been improvements, which the publishers should have thought of.

MICROSCOPICAL DIAGNOSIS OF TUBERCULOSIS, by Dr. Paul Paquin. Oblong 16mo., pp. 48. Battle Creek, Mich.: Little Blue Book Co. Price, 55 cents. It is a common occurrence for THE MICROSCOPE to receive requests for help in acquiring the skill needed to prepare the *bacillus tuberculosis* for microscopical study. The physicians that make the request are usually busy country practitioners that feel that they should be able to demonstrate the bacilli, and desire instructions to that end. Until this praiseworthy little pamphlet appeared it was only possible to refer such inquirers to the current literature of the day. Hereafter it will be a pleasure to refer them to Dr. Paquin's

essay, in which he has clearly and concisely described the means of staining and of examining the bacillus. His method of staining seems to be a good one; it is at least expeditious, as he claims that the bacillus may be colored and the slide finished in from six to ten minutes, the bacilli, by his methods, being red on a green back-ground. Any man with a microscope and two grains of the common sense ordinarily called gumption, can, by following these simple directions, find the bacilli, and so aid himself as well as his patient. The little book should be welcomed, as the reviewer believes it will be. If Dr. Paquin should prepare the stains needed in his method, and sell them at a reasonable price by mail, he would place bacteriological beginners and amateurs under increased obligations to him. The illustrations in the book are excellent.

STAINING AND PERMANENT PRESERVATION OF HISTOLOGICAL ELEMENTS ISOLATED BY MEANS OF CAUSTIC POTASH OR NITRIC ACID.—By Simon Henry and Mrs. Susanna Phelps, Gage. Reprint.

ON THE GERMICIDAL ACTION OF BLOOD SERUM AND OTHER BODY FLUIDS.—By T. M. Prudden, M. D. Reprint.

THE METRIC SYSTEM AND THE SEVENTH DECENNIAL REVISION OF THE U. S. P.—H. M. Whelpley. Reprint.

CALENDAR FOR 1890–91. Botanical Society of Western Pennsylvania.

EDITOR THE MICROSCOPE:—

Until I had received the Griffith Club stand which you sent for examination, I had never seen the instrument, and I am confess that I was prejudiced against it, although "I

had no other but a woman's reason: 'I think him so because I think him so.'" But I was mistaken in every particular. Where I was disposed to criticise the Griffith stand is exactly where it needs no criticism. The pictures which I had seen of the instrument lead me to think that the old saying was true, that "A marline spike could not be used as a cambric needle, nor a cambric needle as a marline spike." The actual instrument, however, is graceful; it is built on sound scientific principles, and it possesses a greater number of essential conveniences than any other stand of its price that I have ever examined. To be able to place it in a small box by simply removing the foot, and to be able to carry it in one hand to the ends of the earth, are no small items in its favor. It is, as Mr. B. F. Quimby has said, pretty nearly the traveling stand that you called for in a recent editorial note.

The removable foot is transformed into an excellent centring and decentring turn-table by placing it on an upright standard provided for it in the case. To receive a ten dollar turn-table as a present when buying a stand is something that I never dreamed of, but I find the reality very pleasant.

The foot is screwed to the pillar in a moment, and when the mirror is turned down in position the stand is ready for the objective. The substage carries an adapter with the society screw, so that an objective may be used as a condenser, and the substage is movable by an effective and simple means so that the condenser may be focussed. It is also of the standard size; it will therefore carry any apparatus, even that made for the largest stands. It is precisely the size of the same part on my own instrument, which is one of the largest in the market today. It possesses another quality which will be appreciated by all that use the polariscope. This is its ability to be swung aside so as to leave nothing between the mirror and the object, a very commendable and useful arrangement, as it enables the observer to study the object alternately by polarized and by ordinary illumination.

But on the stage is what should do good to the heart of every working microscopist. It is the clips. I have looked them over carefully and have tried them as carefully to see if I could not find something in them to substantiate my former foolish opinion of the stand. But they are to be commended in every way.

There is with them not the shadow of any danger that they will turn and pulverize the thin glass and rend the object. They cannot. They are immovably fixed to a transverse axis; they both move upward together, and both may be lifted and turned entirely away from the stage by a slight pressure of the thumb. They have no lateral movement. There is no other microscope made with spring-clips so conveniently and so acceptably arranged. It is really a pleasure to manipulate the slide beneath them, and not a terror, as it is with the ordinary loose affairs that compel the microscopist to keep one eye on them while he examines the object with the other.

Every microscopist's morals would be improved if the opticians could arrange with Mr. Griffith to use his perfect spring clips. These alone would decide my choice between this instrument and another of the same or even lower price, and with all the conveniences of this, but with loose clips. The time has passed when the microscopist should submit to be handicapped by the relics of the dark ages.

Another commendable feature is the fine adjustment. I think this is unique. So far as I know it has never been applied to any other stand. Since the instrument does not belong to me I have been tempted to take the fine adjustment apart "to see the wheels go round." Like "Budge," I am curious on this point. But whatever the mechanism may be its action is slow, smooth and sensitive.

I return the instrument to you as you request, but I do so with regret. It may be conscientiously commended to any one, beginner or otherwise, that may want a convenient, portable and serviceable instrument. Within the limits of a letter it is impossible to describe all its good qualities; I can touch upon a few only, but these few will be sufficient to show the reader that the new and improved Griffith Club stand is a desirable one.

Again let me say that I am sorry to part with it.

Very truly yours,

AN AMATEUR.

PLATE I.

PHYSICAL CAUSES OF HEART DISEASES. EPHRAIM CUTTER

Fig. 1.

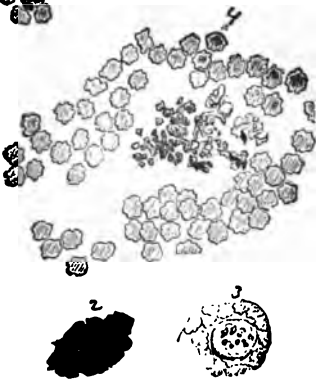


Fig. 2.

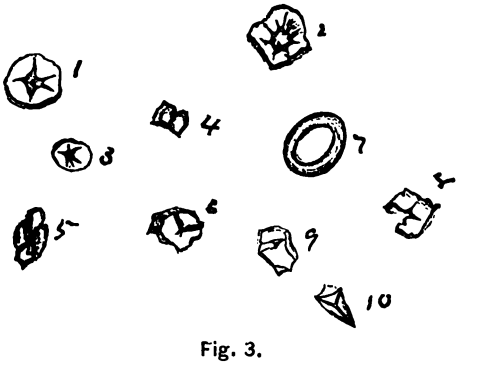


Fig. 3.

FIGURES 1 & 2.—**Crystals and crystalline bodies found in the blood of cases of Rheumatism.**

FIG. 3.—**Crystals of cystine found in the blood of a case of Sciatica.**

THE MICROSCOPE

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ORIGINAL COMMUNICATIONS

THE ESOTERIC BEAUTY AND UTILITY OF THE MICROSCOPE.—III.*

THE MORPHOLOGY OF RHEUMATIC BLOOD.

EPHRAIM CUTTER, M. D., LL. D.

INTRODUCTION.—It is not intended to make this paper exhaustive, but to point out the prominent features. This corroborates the Salisbury paper in the Am. Jour. Med. Sci., Phila., Oct., 1867.

Examination immediate, not mediate.—1. Collection. Specimens must be removed from blood stream as quickly as possible. The patient should be present and the blood should be examined directly, with no loss of time. This is particularly insisted on, as there is a general impression that blood can be collected by anyone and kept almost any time before examination. Mistakes have come from this misapprehension. 2. Kind of blood col-

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lected; capillary, not venous, nor arterial. 3. Site of collection. —The forearm, near the wrist. With some persons the fingertip is a favorite place for collecting blood, but the fat and dirt found there are objections, to say nothing of the needless pain of nerve papillæ puncture. If dirty, the forearm should be washed with soap and water, or ammonia and water, and rubbed dry with a clean towel previous to puncture. 4. Instrument for collecting the blood. Codman and Shurtleff, Boston, Mass., prepared the writer's scarificator, that can be buried to the depth desired with a single sudden painless motion. It is desirable to obtain no more nor no less blood than is sufficient to fill the space between an ordinary cover glass and slide. This amount is a drop about one-eighth of an inch in diameter. By thus preserving a uniformity in the size of the drop of blood as near as is possible, one can form an approximate judgment of the comparative number of corpuscles in different specimens, and the relative proportion of the serum to red and white corpuscles and of the red and white to each other. Best to clean the scarificator point by driving it into a clean towel after each use. 5. How to get the blood. Having the forearm and the instruments ready, the observer grasps the wrist with the left hand so that the skin is drawn tense; the scarificator in the right hand of the observer is applied to the radial or ulnar edge, whichever is held uppermost, avoiding veins, and the point is entered by approximating the thumb and fingers holding the scarificator. The point then pierces the skin so quickly as hardly to be felt, and if the capillary circulation is good, the cut fills with blood and exudes. Usually the sluggish circulation requires a squeezing of the cut to make the drop exude. A clean scalpel is then used to scrape off the blood and to transfer it to the slide, or the slide can be touched to the drop directly, when it is immediately covered and transferred to the stage of the microscope, previously prepared. 6. Power employed. Objectives, $\frac{1}{4}$ to $\frac{1}{16}$ inch; eyepieces, 2 or 1 inch. The writer uses Tolles'.

What to look for in rheumatic blood. 1. Red corpuscles, form, plasticity, adhesiveness. In rheumatism they are sticky and adhesive, outlines winged, huddling to- idges or irregular masses like frightened sheep in a for shearing. They act as if their covering of

neurine was removed, hence they travel with friction through the blood vessels and adhere together. 2. White corpuscles. They are apt to be too numerous, enlarged in size and filled with granules, which may or may not be salts in granular form, as the blood in rheumatism contains more saline bodies than normal. They also adhere to each other or foreign bodies and are found in thrombi and emboli. 3. Serum. After the blood has been a short time on the stage the serum will become filled with: (A). Fibrin filaments in network in the small meshes and strong threads, while in healthy blood the meshes are large and the threads so subtile and minute as almost to elude observation, like the outside hyaline carapace of a *Stephanoceros*. These same small meshes and strong-threaded fibrin filaments are seen in consumptive blood, and are due to a rheumatic complication. (B). Fibrin filaments in larger threads, ribbons and skeins. These are very marked at times in size and length. They oftentimes form skeins of considerable size and length. When long and narrow they will run through two or more fields of the microscope. Often they are of such transparency as to be almost overlooked, but usually they are of a white color, appearing like strings of fibrin in the blood, which they really are. When the red corpuscles crowd around them as crystals of sugar about a string in syrup, and a ridge is seen of unusual prominence, length, twists and curves, then a curl of fibrin filaments is usually found to be the basis of the configuration. Sometimes the skeins are inextricably coiled and curled up. Sometimes they are free like a lock of combed hair. Sometimes the skeins are very numerous, in which case embolism is to be feared. Sometimes they are few and isolated. Their unevenness and transparent snowy whiteness are usually enough to diagnosticate them from the mycelial filaments found in the blood, and which belong to the vegetable kingdom. They are found during pregnancy, and I have no doubt become a serious complication in some cases. Nature will clear them out of the blood if she has a chance to do it. (C). Fibrin filaments in thrombi that become emboli. These are found simple when you can readily trace the filament curled up on itself many times and retaining its cylindrical character. Or the mass is made up of the filaments with their body substance melted or fused to-

gether so that all trace of the filaments is lost, as in mother of vinegar, or embracing within their substance red and white corpuscles, crystals either entire or fractured, one or all. At times they are very large comparatively, and are probably formed by mechanical accumulation on the periphery of other fibrin filaments or form elements encountered in the blood stream, as a snow ball grows by rolling in the snow. The presence of such bodies in the blood stream sufficiently explains the formation of fibrinous concretions on the valves of the heart or amongst its columnæ carneæ. Sometimes they are very large. For example, in the heart of the late Dr. Benjamin Cutter, the father of the writer, two fibrinous concretions were found, each measuring eight inches in length. One originated among the columnæ carneæ of the left ventricle and extended into the aorta; the other arose among the columnæ carneæ of the right ventricle and extended into the pulmonary artery! It is easy to understand local swellings about joints and other parts of the body when such thrombi or clots become emboli or plugs in the adjacent blood vessels. When such are found in the blood of a patient there is need of immediate treatment, for sudden and otherwise mysterious deaths have been traced back to embolism. So if any proof of the value of the microscope in physical exploration was needed, this instance would serve and show that it is not a mere toy. This is not a paper on treatment, but it may be in order to here intimate that ammonia baths, and one pint of hot water flavored with the aromatic spirits of ammonia drank one hour before each meal and on retiring to bed, with medicines addressed to putting the liver, skin, kidneys and other emunctories in good condition, and regulation of diet will soon remove such thrombi, and no cure is thorough unless the microscope shows that the blood is restored to its normal morphology. Such is the positive value of the microscope in the treatment of rheumatism! (D). Crystalline bodies. These are generally, 1, cystine; 2, oxalate of lime; 3, phosphates; 4, uric acid; 5, hippuric acid, etc. These bodies are found in the human body normally in the urine and fæces, but usually in the blood when imperfect feeding or some other cause has deranged the functions of digestion, assimilation, organization and excretion. If the salts are found in too great quantity to be kept in

solution by the eliminating fluids they accumulate in those fluids. Uric acid is more soluble than oxalate of lime or cystine, hence it is natural that the latter are oftenest found in the blood. The phosphates of lime, soda and magnesia accumulate likewise. The physical presence of these salts in the blood, fluids and tissues of the body seems to be a sufficient cause of the pathological states we call rheumatism. The proof of this lies in the fact that when these crystals are removed along with the other conditions named, a cure is effected. It is true that persons may have the morphology of rheumatic blood, and yet have no pains, no swellings, no troubles that they can detect until they are upset by a cold or some other exciting cause. It will then be more accurate to refer the morphology of rheumatic blood to the domain of predisposing causes, it being comparable to the ammunition in a gun barrel, the cold or other exciting cause being like the pulling of the trigger. The explosion may be called rheumatism. If the gun is not loaded, or the trigger is not pulled, there is no explosion. So if the predisposing and the exciting causes are not present we cannot have rheumatism. Once the morphology of rheumatic blood was found in a lady apparently in perfect health. She was surprised at the diagnosis, but coming later in contact with an exciting cause, she wrote, "You were right about my rheumatism;" and thus her case affords an instance of the value of the microscope in medical exploration. (E). Pigment matters. These striking objects are very impressive, and give the observer an idea that they come from the morphology of air, and hence are foreign bodies from outside the body. Giving all due allowance for this source of error, long study has convinced the writer that they, some of them, belong to the morphology of rheumatic blood. Their peculiar beauty of emerald green, bronze, yellow, black, in various shades, all invisible and unknown without the use of the microscope, opens up a new and lovely field of medical thought. What their chemical nature is is unknown. This is a nice problem for solution. For our purpose, which is clinical medicine, it is enough for us to know their presence and to get rid of them by putting Nature's means of elimination in good order and giving her force enough to remove them. This, to us, seems the true way to practice medicine. 1, Cystine,

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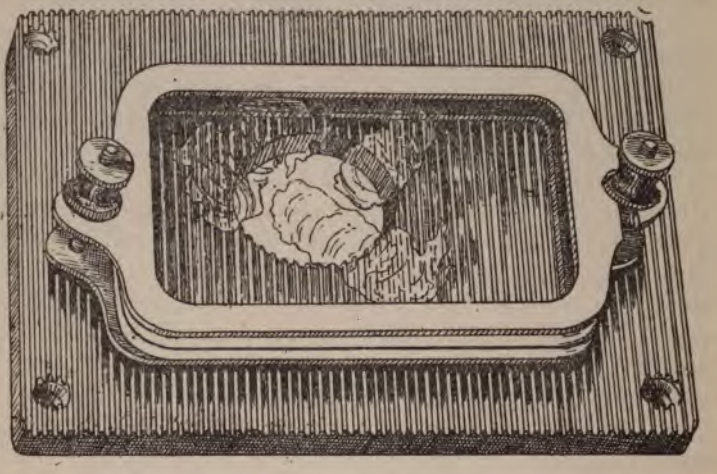
and during the short and frequently dark winter days this is quite an object. No especial skill is required for the work or previous experience with the microscope. A week generally suffices to break in a novice. Ladies prove best adapted for the work. Patience and conscientious care are the qualities chiefly called in use. Trichinæ are found but rarely here, but we are prohibited from giving details in this regard. We work slowly, each lady doing now from 12 to 15 an hour, and they work five to six hours a day generally, with an intermission at noon. Generally the work does not seem to affect the eyesight, but after a dark day they are indisposed to use their eyes much in the evening, but no one so far seems seriously affected. The work here is done at the abattoirs, only two here from which meat is exported. This affords me opportunity to verify each find of Trichinæ by examining duplicate samples, which I invariably do, to make sure that there has been no error in tagging. The Government began here August 26, and we are now inspecting about 7000 animals a week at the two establishments, with 17 assistants. All hogs found trichinous are immediately destroyed, rendered out for soap grease.

As regards the character of the Trichinæ found. They are almost invariably encysted, and when found free it is generally evident that they have become so by pressing and rolling the slides on each other. On heating gently—as in direct sunlight, they will move and generally burst their cysts. Dead Trichinæ are not infrequently found, some scarcely recognizable except by the cysts. All such are condemned and the carcasses destroyed, and it frequently happens that further search discovers some live ones in the same animal.

Early in the work I became convinced of the need of some arrangement to insure the bringing of every portion of the preparation into view. The ordinary mechanical stage I found too slow in operation and too costly, but I hit upon the following simple device which answers the purpose admirably. Shallow grooves are cut in the stage of the microscope at a distance apart equal to the field of view for the power used, in our case 2 mm. Two ribs are attached to the lower side of the compressor frame for sliding in these grooves. By carrying the frame step by step across the stage, and moving it up and down

in the grooves, all the field is necessarily brought into view. The cut here printed to show this device is not very satisfactory.



The object is not as transparent as represented, and it should cover the whole field. The figure represents the first plate I had made, which was screwed on the microscope stage; afterwards it was found simpler to detach the stage and cut the grooves in that directly. The work was done by the Johnson Electric Service Co., of Milwaukee, Mr. Johnson devising a special tool to cut the grooves and ribs, for these latter are not merely strips soldered on, but they have to be cut to triangular shape and made to fit and accurately correspond to the grooves, so that the motion may be smooth and uniform. I began with one rib, but found two necessary to insure steady motion. When first taken in hand by one accustomed to quick work, the lifting of the frame from one groove to the next seems a little awkward, but after a day or two of work with it this inconvenience is not noticed. I had the first one made October 12, and gradually had the instruments of all of my seventeen assistants thus ...ed at their request and expense. The alteration costs only ...ch instrument where many are done at once. It ...e, be more if a separate stage and frame had to be ...antages of the device are highly appreciated by ...hey not only have the sense of perfect surety ...ll the field in their search, but of not having

to go over it twice; time is thus saved, and they get through work an hour earlier than they otherwise could. As near as I can estimate there is a gain, *for the same effectiveness of work*, of fully a quarter the time. I could, in fact, get along with two less assistants and still have a surplus for emergencies caused by illness, or by an extra number of samples to be inspected, for at one of the abattoirs we inspect all they slaughter. It is more important, however, to increase the efficiency of the operators than to economize by lessening the number employed.

That which especially directed my attention to the need of such mechanical help in the search, was the fact that not infrequently slides would be passed to me for verification, in which I found great difficulty in rediscovering the parasites in cases when only one or two were present. It is not unusual for pieces got a second time from the animal to show no Trichinæ until several preparations have been made. These facts show that Trichinæ may easily be overlooked, or not be present at all in the first preparation made, even though the slide be covered with fibre taken from those parts of the animal most profusely infested. In view of this practical value of my device I was urged to patent it, and did make application, but I withdrew it on finding that it would be apt to prejudice the Bureau officials against the general adoption of the device. It is now free for any one to use or improve upon, and I trust some such plan will soon be introduced at all the Government stations. Mr. W. T. Johnson, of the above named Electric Service Co., has an idea of a mechanical stage, which, though more expensive, would be better, namely, to impart to the slide carrier a special motion starting from the centre, and regulated to cover all the field, with a rapidity dependent on the power used and the will of the operator. Such a piece of mechanism, he thinks, could be furnished in quantity for five or six dollars each, and it would require a different shaped slide from that now in use. If making a frame myself to carry the slides I should have simple springs on the sides to hold them in place, with a ledge to rest against on one side. I have modified the compresser frame by adding such a ledge strip to the bottom piece and, taking off the top piece, had brass washers soldered to the little screw nuts, using these to keep the slide in place. Nothing more is requisite, and this allows quick adjustment.

If any of your readers wish to avail themselves of the facilities afforded here for having such a grooved stage device attached to their instruments I shall be glad to see to the work for them.

EDINGER'S DRAWING APPARATUS.

DR. JOSEPH COLLINS.

Many able workers with the microscope are hindered from reaping and sowing the full benefit of their work to others by reason of their inability clearly to delineate on paper in the shape of drawings, the result of their researches and labor. Up until a few months ago the only aid that could be called into use was the ordinary camera lucida, and only those of us who have made use of this know how unsatisfactory it is. It seems to have been left to my greatly respected teacher, Dr. Ludwig Edinger, of Frankfürt à Main, to demonstrate to us that a very simple optical device could be utilized for weak magnification and drawing, so that by its aid the merest tyro could make a drawing which would possess that most essential of all prerequisites, viz., accuracy.

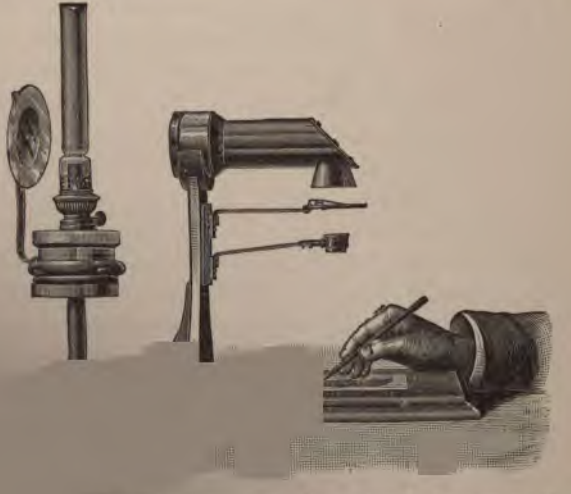


illustration will show that the apparatus con-
le of a flat board bearing an upright, made

also of a narrow strip of wood, and supporting a sheet cylinder which runs parallel with the support. The upright is grooved on its front surface, and into this is fitted a slot which allows the terminations of two narrow arms to slide upward and downward; the lower of these arms terminates in front in a small circular opening for the reception of the lens to be used in magnifying. The upper one terminates in a circular plate which is perforated by an opening equal in size to that of the opening for the lens in the termination of the lower arm below; this circular plate is the carrier of the slide bearing the preparation. On the back surface of the upright is a large piece of canvas board (not shown in the illustration), which may be made firm by cutting a hole in the centre of its upper portion so that it will fit the end of the sheet cylinder used for conducting the rays of light. The purpose of this board is to cut off all the rays of light except what passes into the cylinder. An ordinary petroleum lamp with a good burner, a gas jet or an electric lamp may be the source of the light. I have found a small lamp with a reflector will answer every purpose admirably.

The slide bearing the object to be drawn, having been placed on its bearer, the little circular plate and the light in position, a piece of drawing paper is placed on the stand beneath the lens. The next thing to decide is how large you wish to make the drawing, and so use a correspondingly weaker or stronger lens. Then with the lens in position you focus by sliding the arm bearing the lens, the upper arm bearing the slide being fixed, upward or downward until an accurate focus is shown to be obtained by a delineation of the object on the slide on the paper beneath.

Although the canvas board will cut off sufficient of the rays of light to allow the outlines to be well marked, it will be found that working in a dark room with no light save the one used for the apparatus will be more conducive to a clear delineation. By regulating the height of the arm, and by changing the lens, any magnification between two and fifteen times can be made.

Frequently it will be desirable to make only the outlines of the drawing with the apparatus, and then to fill in the details from the microscope; for instance, if one should desire to make a drawing of the medulla spinalis in three colors, the outlines could be made with a pencil and then erased till only a guiding

trace of the pencil marks was left, and then the surface could be gone over with any of the aniline dyes, largely diluted, so as to represent the ground work of the stain, and the medullated fibres and the ganglionic cells filled in respectively with black and red ink. With the apparatus specimens colored with dark stains will give a more clearly differentiated picture than the light ones.

The instrument has been made for me by E. B. Meyrowitz New York, and is to be had with two or three lenses, two are all that are necessary ordinarily, but the third is useful sometimes when the object to be drawn is small and where you desire high magnification.

NOTES OF THE DIATOMS OF THE FLORIDA COAST.

CORNELIUS ONDERDONK.

One of the commonest forms on the Florida coast is the one wrongly classed as *Eupodiscus radiatus*. It is evident that this Diatom was classed with *E. argus* wholly on account of the four short processes called spines, while the structure of the entire valve was ignored. It is evident to the careful student that the structure has much to do with the life of the organism, while a mere spine is of small importance. The structure of *E. radiatus* is identical with the most common forms of the *Coscinodisceæ*, viz., a sharply cut, purely siliceous hexagonal network, over which is laid a membrane containing areolar indentations, whose positions correspond with the hexagons of the frame work. The structure of *E. argus* is totally different. It seems that writers have found difficulty in determining the structure of this form. I presume they worked with the fossil specimens, for no difficulty is to be found when one examines a number of specimens from the Florida waters.

The frame work is a robust, irregular net work (never hexagonal), nearly purely siliceous in small forms, but ochreous, and heavy with what I will call an argelaceous deposit in the ge opaque forms. If one examines a number of frustules one portions from which the semi opaque deposit is re- ing the siliceous net work sharply defined. The ne has minute dots placed in radial lines without

regard to the form of the network of the frame. In the case of *Actinoptychus* too much stress has been placed on mere size and number of markings, for the so-called species run into each other by intermediate forms in the Florida waters. I find a well marked form, however, that I should call a new species since the rays are connected by two granular ridges, near the centre of the radius of the valve. As the valve is six rayed, the ridges form two pentagonal figures. I would call it *A. pentagonalis*. The general markings seem to resemble *A. nitidus* (Wolle's Diatomaceæ of N. A). I have as yet found but one specimen, but the pentagonal zones are so conspicuous as to leave no room for error.

One of the most beautiful of Diatoms is *Surirella Febegerii*, and it is by no means rare on the Florida coast. Another gem of the first water is *Amphiprora vitrea*, or rather I will call it a variety of that Diatom, and name it *A. vitrea regalis*. It is twice the length of the figure in Wolle's Diatomaceæ of N. A., being about .01 inch in length. This Diatom would make a good test object, as it is very constant in size and striation. The lines are transverse, about 60 to 1-1000 inch. The surface of the valves is wavy lengthwise, so that the lines seem interrupted. It takes a fine glass to show it well.

ELEMENTARY MICROSCOPICAL MOUNTING.—V.

DR. A. M. WEBSTER.

BROWN'S RUBBER CEMENT.

This is an almost colorless solution of pure rubber in benzol. It is exceedingly thin, and for that reason somewhat difficult to use until the microscopist has had a little experience with it, when it becomes tractible and commendable for certain purposes. Unless the brush is filled properly with just enough to do the work well the tendency is to run over the slip, where it is not wanted. If the brush is too heavily loaded the cement will spread irregularly over the slide, and the result will not be pleasing; but if a little is used and several successive applications be made, the fluid is an excellent one. It is not to be commended for the building up of cells, but as a finishing application to a balsam mount, or to one cemented down with shellac or

some other cement, it adds an attractive finishing touch. It is perfectly transparent and usually almost colorless; that which I now have, however, has become a dark reddish brown, although it has been kept in the dark. When dry this is also slightly colored. It may be used to fasten the cover in place over a mount in glycerine, as I have several times done, yet it is rather more trustworthy when added over a ring of shellac or other cement to give a glossy transparent surface, and to add its little quota of strength to the cell. Even when used alone to fasten down the cover, when the cell has been made of some other material, it has little tendency to run under, especially if only a small drop be used at a time. It dries rapidly, and almost any number of applications may be made in somewhat rapid succession. The reader should be told, however, that too much friction of the brush is likely to give the finished ring a milky, semi-opaque appearance. With care it is capable of doing good work, and is to be commended. The microscopist cannot readily make it himself, but must buy it of the dealers.

After using this cement the brush should be cleaned with gasoline rather than with alcohol. The latter will produce a whitish, curdy deposit that is not easy to remove.

GOLD SIZE.

This is a liquid cement used chiefly for building up cells, and for attaching metal rings or other objects of the kind to glass. It dries with exceeding great slowness, but is highly commended by some microscopists, although it is not now very generally used, the slowness with which it dries being one objection to it. But when once its volatile parts have evaporated the remaining product is said to have wonderful tenacity. I have never used it; my report is therefore dependent upon the experience of others. It is made by taking

Linseed oil, 35 ounces;

Red lead, 1 ounce;

Powdered white lead and yellow ochre, of each a sufficient quantity.

l the oil and red lead together carefully for three hours;
the clear liquid and boil with a mixture of equal parts
e lead and yellow ochre added in small successive
et it stand and pour off the clear liquid for use.

In reference to its employment as a foundation ring, Mr. Fr. Dienelt says:* It answers much better than shellac in mounting insects, whole or in parts, or than other materials where a thick layer of balsam is needed. Much trouble is caused in finishing with alcoholic cements, because the alcohol softens the thin crust of hardened balsam at the edge of the cover, and air bubbles appear. The same often happens again when finishing with colored cements. With glycerine mounts, that is, when glycerine is used as the preservative medium to surround the object beneath the thin cover, then the finishing cement may be Brown's rubber solution; and in similar instances shellac may be used to fasten the cover in place over a cell of some other cement, but as a rule it seems to me best to use the same cement for both purposes. In this way all danger of chemical action between the two is avoided. If ornate slides are desired they may be made by adding stripes around the cover with shellac colored with any of the aniline dyes, or with the beautifully colored cements prepared by the Rev. J. D. King, of Cottage City, Mass. But, again it seems to me preferable to avoid the use of these colored applications, unless it can be done with skill, as otherwise the result is likely to be tawdry.

Gold size has the advantage of possessing little or no affinity for Canada balsam, unless the latter is used unprepared by the microscopist or by the dealers, that is, unless it is used as in the condition in which it is when bought at the druggist's, a method that is almost never employed at the present time. Another exception is when the balsam is thinned with turpentine, but this is another thing that is seldom done. The balsam is almost always put through certain processes, as we shall learn hereafter, and then dissolved in benzol, chloroform, or in some other menstrum that evaporates rapidly. The reader need have no fear that his thinned gold size will run under the cover unless he uses, as he should not, the ordinary Canada balsam to be had from the druggist. All this will be referred to again, at the risk of repetition.

Gold size may be used to fasten the cover in place over a balsam mount, and this is a great advantage, as every balsam mount should be protected by something of the kind, although the hardened resin will for a long time hold the cover in position; it will

* THE MICROSCOPE, September, 1890, p. 281.

in time, however, become so brittle that a slight jar may send the cover and the object flying from the slide. To prevent this, gold size has been highly recommended.

In the article already referred to, Mr. Dienelt further says: "Gold size is slow in drying, but if one builds a number of cells to-day, they will be exactly a month old a month from now, and in time will get hard as glass. Make them with one or two, seldom three, successive coats, and always aim to have a lot of old cells on hand." When they are to be used, a thin coating of the size is added to the ring, the object arranged in the cell, and the cover applied to the soft surface of cement, and a finishing ring added at the edge, with colored rings, if desired, when all is dry.

Mr. John Phin, in his little book "How to Use the Microscope," says in reference to gold size: "The most extraordinary recipes have been given for the preparation of this cement, which is in reality nothing but good linseed oil rendered very drying by the usual methods. Gilders frequently make it into a semi-paint by adding coloring-matter, thus forming a ground of a shade similar to the gold they use, and this seems to have misled some of our best writers. There is no ochre, litharge or anything of the kind present in good gold size. It does not pay to prepare gold size in small quantities, and it may be obtained from any color dealer. The older it is the better, and it is well, therefore, to lay in a good stock, which must be kept carefully corked. The working supply should be kept in a small bottle. This is the favorite cell-making material employed by Dr. Carpenter, and it is certainly the most trustworthy cement that we have. It adheres firmly to glass, and if laid on in thin successive coats, tolerably deep and very durable cells may be built up, but the process requires considerable time, otherwise the under layers will remain soft. It has this great advantage over asphalt, dammar, and other cements composed of solid materials dissolved in some menstruum, that fresh coats have but very slight action on the old layers on which they may be laid. It mixes with turpentine, and consequently with most materials soluble in turpentine, but when once dry and hard turpentine, alcohol, ether, etc., have little action on it. It does not mix with alcohol, and therefore cannot
solution of shellac in alcohol in any of its f
probably wrong in saying that the cement

anything of the kind; at least he stands alone in making the assertion.

MARINE GLUE.

This is a solid that can be used only with the application of heat. It is troublesome, but one of the most tenacious of cements for fastening metal rings to glass and for similar purposes, yet the beginner can easily get along without it. To use it, the cement, the slip and the ring must be heated, and the fingers are frequently uncomfortably heated as well. It is composed of India rubber, shellac and naphtha melted together and allowed to cool.

The dealers supply a liquid marine glue that may be used without heat. It is said to have almost as great adhesive power as the ordinary solid form. I have had no experience with it and have nothing to report from the experience of others.

RINGS FOR DEEP CELLS.

It often happens that it is necessary to mount a large or a thick object, and that a cell deeper than the ordinary kind is needed. To build up these deep cells with cement is neither safe nor convenient. If made of several layers applied on one another the cell is more likely than not to leak, because the walls easily crack or separate slightly from the glass and allow the air to enter and the mounting medium to ooze out. And to make these deep rings is not easy, as the first layer of cement must be allowed at least partly to dry before another can be added, and this takes time, sometimes a good deal of it. A better way is to fasten a deep metal or other ring to the slip, and thus to make a cell of almost any depth, the latter of course depending upon the thickness of the circle used. The rings are for sale by the dealers and are of brass, tin, glass, rubber or of some other serviceable material. With the exception of the glass rings and the cheapest brass ones, they must all be bought; but these exceptions are usually all that the microscopist will need and are as useful as those that are purchased. The home-made glass rings are admirable, although their edges may not be as smooth as the edges of those bought at an enormous price from the dealers; but the satisfaction of making them and of thus being independent of all outside help, atone for rough edges and for somewhat irregular appearance, espe-

cially since they may be made for next to nothing. The reader will find that it will add a good deal of pleasure to microscopical work to make one's own tools, as nearly all that the microscopist needs may be so made. Glass slips and covers and a few chemicals he is forced to buy; all else he has within himself, if he is the least ingenious. And indeed, he need not be ingenious, if that term should mean of an inventive turn of mind, for the books give explicit directions for the making of the few tools that the worker will need. At least that is one of the objects of this little manual. The making of glass rings will be referred to again with directions as to the method.

Deep cells are used so that with large or thick objects the cover glass may not be forced to lie upon the specimen. If the object were compelled to bear the weight of the cover it might be crushed or injured, and the thin cover itself would be in danger of breakage. The breaking is easily done at any time, but to have the glass resting unevenly on the object would be to invite disaster. The difficulty also of cementing the cover in place over a thick object is greatly increased. A thick ring is therefore cemented fast to the slip, the object and the mounting medium placed within it, and the cover put on the ring and cemented down.

METAL RINGS.

The dealers have for sale fine rings of block tin of various thicknesses and diameters. These are excellent; they make a pleasing mount, and the microscopist will need some of various sizes, if he is to do much work with large and thick objects. No mounting medium should be used with them that will have any chemical action on the tin, or the preparation will soon be spoiled. They should be selected for the largest and thickest objects only. For thinner specimens there is another kind to be had nearer home.

These are curtain rings of brass, to be had in various sizes from any hardware store. Select the size needed and with a hammer pound them flat on a smooth, hard surface, like that of sad-iron, for instance. It needs a little skill to do this without
r and so ruining the ring, but slight practice will teach
or comparatively thin objects, are as good as the tin
nly possible objection to them is that if they are
that the surfaces are in contact, when they come

to be used with fluid or with balsam mounts, the air in the hollow of the tubular ring will in time ooze into the mount, and perhaps lift the cover, or do some other damage.

PAPER RINGS.

Another kind sometimes used and capable of being made at home are rings of paper soaked in shellac, and dried. Paper of any desired thickness is cut into disks, preferably with a gun wad punch, and made into rings by cutting out the centres with a punch of another size. These rings are then soaked in thin shellac until thoroughly saturated. When dry they can be kept for any length of time, and fastened to the slip by being gently heated or by being wet by a drop of shellac. With care, good rings may be made very cheaply in this way, and sightly mounts prepared with them, but they are brittle and must be handled with caution.

HARD RUBBER RINGS.

Vulcanite or hard rubber rings must be bought of the dealers, if desired. They are better than tin only in being lighter, a thick rubber ring being less weighty than a thin tin one. I do not know that they have any other advantage, except perhaps in price. Like the other kinds they can be had in various thicknesses and diameters.

THE ATWOOD RUBBER CELL.

The Atwood rubber cell is a solid rubber disk, with a concave upper surface, in which the object is placed. Around the edge is a depression to receive the cover glass, and the whole is cemented to the slip. These cells are intended only for opaque objects, that is, for those which must be examined with the microscope when the light is reflected down on them from the mirror rotated above the stage, or by the bull's eye condenser. Their use is therefore rather limited. For their special purpose, however, they may be commended, although there are other ways of mounting opaque objects quite as good. The cells seem to be made to receive only a half-inch cover glass.

THE PIERCE CELL.

Another cell somewhat similar to the Atwood, but made from brass, and with a cap-like cover, is occasionally seen; but I do not know that it is in the market. It is the Pierce cell, and con-

sists of two parts, one the cell proper, being a ring on a thin disk-like base, the disk giving it a broad surface for attachment to the glass; the second part is the cover which slips over the vertical ring like a cap, and makes the cell air and dust tight. The object is placed within and covered by the cap, which must be removed whenever the object is to be looked at. The contrivance can be used only with those specimens that are mounted dry, that is, with no preservative medium except the air that surrounds them. There are not many specimens that can be dried successfully to serve as microscopic objects. Some that exist naturally in the dry state can be so treated, but as a rule it is better to mount in some fluid medium, especially if the object is naturally moist. Minerals, some fungi, and similar things can be preserved dry.

This being one of the "r" months the microscopist may turn his attention to the oyster. But it is chiefly as an interesting subject for those leisure hours or moments of the evening, when everything is quiet, when the children are in bed, and there is no one to "bother round." It is then that he may carry into his "den" a few oysters, refusing to answer such questions as, "Do you mean me to understand that you can find bugs in them?" or, "I think it's real mean in you to find things in oysters." There may be not exactly "bugs" in oysters, but there are "things." And it is these things which will give the microscopist a good chance to show his skill in manipulation, skill in the use of his eyes and of his objectives, as well as ality of his optical outfit. This list does not include his patience; he will need an extra supply of that. The cts to be studied are worthy of extended considera- because they may be used as tests for objectives, nce, but on account of their simple yet interesting habits. They are certain animal parasites which

live in great numbers in the stomach and in the intestine of the common oyster.

Nature seems to have placed the mouth of this "luscious bivalve" at the wrong end of the body; it appears to be at the posterior extremity, because it is located near the hinge of the shell, and not, as one would be likely to suppose, at the end toward the free margins of the shell. But as the arrangement seems to be satisfactory to the oyster, the human animal has nothing to complain of, except, perhaps, of the difficulty in finding it when he desires to remove the stomach contents for microscopical examination.

The large, pearly, somewhat cartilaginous mass often called the "heart," is the severed muscle that holds the valves of the shell together. Place the oyster so that this muscle shall be towards you and on your right hand side. In the left hand margin is included several membranes. Pick up with the forceps the first and lay its whole length back on the body of the oyster. This is the mantle. To lay aside the whole length it will be necessary to tear the anterior border for perhaps a quarter of an inch. The gills (the "beard") are now exposed, but they need not be disturbed. In front of them, however, and entirely free from them, is an almost semi-circular appendage, separable into four parts. These are the oyster's lips. They differ in appearance from the gills, being slightly different in color and less conspicuously striated. Lift one and lay it on the upturned surface of the mantle. If the latter has been sufficiently torn at the anterior margin, the oyster's mouth will now be plainly visible at the extreme end of the body as an oval, widely open aperture.

Into this ever open mouth gently thrust the point of a glass tube having a rubber bulb at one end. When the point of the tube has penetrated for half an inch or less it will be in the oyster's stomach. Allow the bulb to expand and the stomach contents will rush in and be at the microscopist's disposal. The liquid is turbid, slightly brownish and usually three or four drops in amount. It will probably contain many infusorial parasites which we are seeking, and which are always present in the alimentary canal and usually more or less abundant in the stomach.

You may use any objective from a half-inch upwards, and it

in time, however, become so brittle that a slight jar may send the cover and the object flying from the slide. To prevent this, gold size has been highly recommended.

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microscopical imps would be excusable after the microscopist had tried for three hours to follow them up to get some notion of their shape and structure. When killed by the acetic acid they are seen to consist of two parts, a body which is very similar to that of the common *Spirillum*, although at times and when the animalcule is dying, it shows that it is flexible and capable of assuming new coils or of imperfectly staightening itself. When dead it lies in a long loose incomplete coil, or in an undulating line. It has no mouth, no nucleus, no contractile vesicle, no internal organs, and only a single external appendage, that which produces its lightning-like movements. This appendage is a narrow membrane attached in an undulating course to one side of the Spirillum-like body, but not, as some investigators have said, encircling the body spirally. It is attached to one side only. Its edge is thickened and the whole membrane, as the reader will soon learn if he attempts to see it during its life, is exceedingly flexible and movable. After death by acetic acid the creature, as well as its vibratile appendage is plainly visible with a good 1-5 objective, especially when the microscopist has, with a higher power, learned what to look for.

The parasites are worth the slight amount of labor needed to see them, not only because they are so lively and so exasperating, but chiefly because they are parasitic within the oyster that everyone is fond of, although the little creatures will not add a single titillation to your gustatory nerves as their host slips down your throat; they are inside the victim and only 1-200 inch in length at the longest, while some are not more than one-third that length. Yet the thought that you are swallowing them when you swallow it may add interest to the act, especially after you have seen them.

ACKNOWLEDGMENT.—To Messrs. James Stratton & Son, Brooklyn, N. Y., for an additional reservoir for their beautiful and convenient microscope lamp recently noticed in THE MICROSCOPE.—To Mr. E. H. Griffith, of Rochester, N. Y., for his focus indicator. This is a simple little instrument, but one that should excite admiration by that simplicity and by the ease with which it accomplishes its purpose. It consists of a flat ring

to be placed between the objective and the body tube with a thumb screw to fasten a movable stop in any desired position. When the focus has been obtained, all the microscopist need do to prevent the objective front from coming in contact with the slide or the cover glass, even in the most awkward and careless hands, is to fasten the movable stop in the proper position; then Samson himself could not bring the lens and cover in contact, unless he should destroy the instrument. Especially in schools where a number of pupils have to look through the same microscope, or for microscopical soirees, Mr. Griffith's indicator should be a welcome assistant. To a novice with his first stand it would be a great help and would relieve him from much anxiety as to the safety of his objectives and covers.

NEWS · FROM · THE · WORKERS ·

THE ZEISS APOCHROMATIC, 1.60 N. A.*—It is possible to push one phase of optical construction so far as to accomplish the object, but to leave doubtful the usefulness of the object gained. We have all heard of the new objective produced by the firm of Zeiss, of Jena. It has a numerical aperture of 1.60. This from one point of view is a great advantage. None would have greater reason to hail it than I, in the special work with which my life has largely been occupied.

Now, I have spent five consecutive days in the close and critical examination of one of these objectives which, so far as I know, has been in no other hands but my own and those to
I have shown it. I desire to take the sole responsibility
ing its value. In my hands it is an extremely beauti-
is well centred, well corrected, and shows plainly
of its enormous aperture. It is a triumph of the
ch produced it. But I would hasten to say that

ger's presidential address to the Quekett Club. Journ.

I would not trust a single result produced by its means, when oblique light in one azimuth is employed, especially with the chromatic flint condenser provided by the firm of Zeiss for its illumination. It is fatal to its truth. We can almost get any desired result with it. It is a very optical Witch of Endor for calling up ghosts and ghostly visions. * * * But now comes the pragmatic question, which we are bound to ask, "What does this objective contribute to the practical work to which, for the attainment of the highest results, the microscope must be applied?"

I say at once, for the amateur and the lover of splendid images the objective may be a delight. But I have pointed out before that even immersion objectives, though they have a great, have nevertheless a very limited, use in strict biological inquires of a certain kind. This is true of water; it is doubly true of oil. If we are examining minute life under a limited cover, the fluid above, between the lens and the top of the cover glass, will ultimately, in following the travels of the living creature, be caused to mingle with the fluid between the cover and the slip, and so destroy the work. But in spite of this, immersion, and especially homogeneous immersion, objectives have an enormous value for experiments in control and comparison. But with the new lens of this great aperture, not only have we to use flint covers, specially and expensively ground, and flint slips, but of course we have to employ a dense mounting medium absolutely fatal to all organic tissues. Flinty and carbonaceous animal and vegetable products, however fine, may be examined by its means; but the cell as such, to say nothing of the living cell and unicellular organisms, can never at present be subject to its optical analysis.

Now it must not be supposed that this fact was not fully known to its accomplished makers when they devised and sent it out; that would be an error. But in our inquiry as to the influence it will exert upon the special work of the microscope in unravelling the structure and deportment of animal and human tissues it is a great factor. In spite of the splendid result attained by it, as biologists we gain nothing. We are where we were, and studies of cells and cell life must be made with dry and immersion apochromatics of N. A. 1.4, or at most 1.5. With this fact before us it will be well for us to remember

what we are searching for as experts, in tracking the life and behavior of various cells, and founding, or endeavoring to found, a comparative morphology and physiology of cells and unicellular bodies.

WAYS AND MEANS

THE CAMERA OBSCURA VERSUS THE CAMERA LUCIDA.—By Henry G. Piffard, M. D. In drawing from the microscope three methods are in vogue: 1. The observer studies the subject on the slide, and when he thinks he has the outlines and details sufficiently impressed on his mind, withdraws his eyes from the tube and commits the mental picture to paper, using both eyes in directing the movements of the pencil. 2. The observer, looking down the tube with one eye (usually the left), is enabled to see the virtual image by a sort of autoprojection delineated on a piece of white paper by the side of the microscope. With the free right eye he guides the pencil in tracing on the paper the magnified map of the object. 3. In using the camera lucida a single eye is used for observing the object on the slide, as well as for guiding the pencil in tracing its reflected image. Method 1 requires a good memory and considerable skill as a draughtsman. No. 2 less skill is required, but the knack of doing it can only be obtained by practice. With No. 3, reasonably normal vision is a prerequisite. The writer has for a long time, perhaps always, been affected with astigmatism and hypermetropia, to which advancing years have added presbyopia, and in consequence is unable to use the camera lucida with satisfaction. In No. 1 binocular vision is employed in the operation of drawing; in No. 2 monocular vision, and in No. 3, ni-ocular vision.

inconveniences referred to may be avoided by a simple
ich the writer has of late used with some satisfaction,
ight angled prism with silvered hypothenuse. This
unted with a short tube extending from one of the
s and of suitable size to enter the tube of the

microscope. A similar short tube of a size to receive the ordinary eye-piece extends from the other square face of the prism. If now the microscope be placed with the tube horizontal and the prism case with eye-piece be inserted, the ocular pointed downward, an image of the object on the stage will be projected on a piece of drawing paper beneath, provided of course that there is sufficient illumination beyond the stage, and that no light reaches the paper except that coming through the objective. Personally I find this instrument much more convenient and satisfactory than the camera lucida. Mechanical micrograms must yield, however, to photographs; and the micrographic science of the future will seek the aid of the pencil less, and make more frequent use of the convenience and accuracy of photography. Bausch & Lomb made and mounted for me the prism described, and I have no doubt will be pleased to duplicate it for others.

EDITOR THE MICROSCOPE:—

I have recently purchased of Messrs. Spencer & Smith, of Buffalo, N. Y., their new series of first-class dry objectives, consisting of $\frac{1}{8}$ of 150°, 1-5 of 150° and 4-10 of 130°; their performance is so striking that a brief account of it may interest your readers.

In the first place they are practically perfect in respect to color correction, their images in that respect being all that could be wished, and quite as good as those of any apochromatic I have ever seen, and I have examined several of Zeiss' best. In the second place the definition is perfect. The $\frac{1}{8}$ in my hands performs especially well with oblique illumination. The 4-10 is a most remarkable lens, performing equally well with both axial and oblique illumination. The resolving power

of all the series is most remarkable. I have never before seen it equalled in a dry objective. Taking the series as a whole I regard them as the best dry objectives I have ever seen.

At the present time it is fashionable to use foreign objectives and continental stands. I have secured and used Zeiss' objectives from the lowest power (3 to 5 inches) up to 1-18 homogeneous immersion, for the last seven years, and they are admirable objectives. I have also had the opportunity of examing Zeiss', Reichert's and Leitz's most recent work, and from such examination I believe that the work of Messrs. Spencer and Smith is fully equal to Zeiss' best, and is certainly superior to any Leitz or Reichert objective I have ever seen.

As to price Spencer & Smith's work is cheaper by far than Zeiss's for the same grade, and I understand that Messrs. Spencer & Smith have a new series of moderate angle now nearly ready for the market that are quite as cheap, or cheaper even, than those by Leitz. Cheapness, however, should be no criterion in the purchase of an objective. Quality should be the controlling element.

These American objectives, as I understand, are all made of the old crown and flint glass whose staying qualities are well known. I am sure from personal inspection that some kinds of the Jena glass deteriorate with age. I do not think that in the matter of purchasing scientific instruments the notoriety of the maker should cut any figure. It is simply a question as to where the most value can be had for the least money. In this respect there is, so far as objectives are concerned, no need of going abroad. The purchaser of foreign objectives will, as compared with the series I have just described, pay more and get less than if he purchased at home.

I shall in a future communication describe a new homogeneous immersion 1-10 of 138° balsam angle. Respectfully,

CHICAGO. M. D. EWELL, M. D., LL. D.

R THE MICROSCOPE :—

atom *Amphipleura pellucida* is considered the most all the diatoms to resolve into transverse striæ. To jective it is a test, and to be able to see its striæ ıll be no doubt as to their visibility, is some-

what of a feat for the microscopist as well as for the objective. Knowing these facts, would it not be surprising to have those delicate lines beautifully resolved with a 1-5 inch objective? It can be done with a dry 1-5 of 135° aperture, and conspicuously done. It is amusing and pleasing and true. The objective is by Gundlach, and in the resolving of *Amphipleura* there is no trick and no catch; the resolution is made by oblique light, and with the two-inch ocular. But although there is no trick, all being as plain and above board as possible, there is an important secret. This is in the mounting medium. The refractive index is the secret. The higher that is the more readily will the resolution be made. That of the medium at my disposal is 2.30, so marked by the mounter of the slide and originator of the medium, the lamented Dr. Allen Y. Moore, a microscopist who died too early; too early in years, too early for the good of the microscopical world, and far too early for those who were attached to him, as was the writer. But in a medium of such an index this excellent objective will resolve *Amphipleura*, and do it with great brilliancy. I do not doubt the success over a similar medium, of other American objectives of this focal length and angle, but it is with this special lens that I have had the pleasure of repeatedly making the resolution.

AN AMATEUR.

NEW PUBLICATIONS

PRACTICAL PATHOLOGY AND MORBID HISTOLOGY.—By Heneage Gibbes, M. D., Professor of Pathology in the University of Michigan; 8 vo., pp. XI, 320. Philadelphia: Lee Brothers & Co. "The following pages," the author says in his preface, "are not intended to form an exhaustive treatise, but to cover the essential points with which the student must become familiar in the work of a pathological laboratory. Such instructions are given as will enable him to transfer a specimen of any morbid change directly to his microscope in an unaltered condition, and to recognize it unerringly." The author has ac-

complished his object most successfully, and has prepared a hand book with "no nonsense about it." The work proceeds calmly, smoothly and with a judicial dignity directly to the attainment of its purpose. A critical critic may easily find flaws in it, as, for instance, the recommending of a stand like Beck's pathological microscope in which the fine adjustment is applied to the back of the stage, an arrangement that any microscopist would condemn, on theoretical grounds, at least. But the book is so well done that to pick out such small defects would be an ungrateful task. Still, although Dr. Gibbes expresses his approbation of the half-tone plates with which the book is illustrated, it is more than possible that the majority of readers will not agree with him. The frontispiece is equal to the best of the half-tone plates which the writer has ever seen; it nearly approaches perfection, but the others fall far below it. They show fairly well the points intended, which may be sufficiently emphasised to the author's eye, but to find those points the unlearned reader must search the pictures and know what he is searching for. The plates do not, as they should, force him to see what their maker intended they should show. The appearances are there but they must be searched for. In other particulars the book is excellent, and a welcome addition to the few really commendable manuals on the subject. Every medical microscopist, especially everyone working over pathological matter unaided will find it a real assistance, as its instructions are actually instructive and show, on their face, that they are the work of a practical teacher who writes from the stores of his own experience. It treats of practical pathology, practical bacteriology, morbid histology, and of photography with the microscope, giving the reader plain, elementary instructions in every essential part of the subject. Dr. Gibbes condemns the use of wide angled objectives in the study of morbid histology, and in this he is not in accord with eminent workers elsewhere. But the following quotation may offset this somewhat heterodox opinion, for it contains matter which every would-be microscopist should ponder: "The student must remember that e is no royal road to knowledge with the microscope; ex-ve apparatus will not help him; honest hard work is the ng that will teach him to understand what he sees with scope."

·THE·MICROSCOPE·

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The Value of Photography to the Microscopist.—I.

By V. A. LATHAM, F. R. M. S.

ANN ARBOR, MICH.

The use of photography in microscopical work is one of the great advances of the day, and yet some authorities are beginning to condemn the combination on account of certain bad results which occur, and these are often due to inexperience on the part of the operators. The more generally photography is known the better the results will be, and one subject must go hand in hand with the other. Again, many specimens are not fit for photographing, either through bad hardening, bad staining, or bad mounting.

Some people prefer drawings of the sections, but in this we have more dangers to contend with than can well be enumerated. Each man's range of vision differs, his ideas, and his power as a draughtsman. People sometimes make drawings of morbid conditions produced by disease in tissues of which they never saw the normal structure. Magnification is often wrongly given. Photography has the power to overcome all this by giving an exact representation of the specimen. Errors in the print can be easily detected by any one who knows the subject. But retouching the negative should not be done, for when discovered discredit is thrown on the whole work.

Photographs are of the utmost value in the study of histological, pathological and bacteriological specimens. The best specimens for photomicrography are the thin preparations which lie as much as can be in the same plane. Certain advantages are left to the draughtsman, while others remain with the photog-

rapher—thick preparations for the one and thin for the other; less expenses and not such accurate results. When slides are scarce and valuable their usefulness may be duplicated by negatives. In drawing we have the satisfaction of showing the *ideal* tissue or point of discussion or illustration. The draughtsman can, by simply focussing the micrometer screw, combine the different planes in one and reproduce the regularity of the specimen. This in photomicrography is impossible. All this is why there are errors and misinterpretations and abuse of this art. It is in the study of micro-organisms, where, if ever, a pure objective perception, free from every preconceived idea, is necessary, for no one will deny that the difference in conception of the characteristics of one and the same object almost always depends upon the fact that the object appeared to the one observer under a different form from that to which it was seen by a second. A slight movement of the adjustment screw will cause a delicate object to disappear entirely from the field, or to appear with different markings and shadows. Results are always aided by the use of the microscope apparatus, light, and magnifying power, but if the conditions under which the objects are seen be different in the matter, say of the size of diaphragms, high or low eye-piece, etc., or if the staining or the mounting of the objects be dissimilar, how can we wonder at the varieties of opinion. To do away with these variations, which in microscopy frequently have been proved to exercise a most injurious influence on the progress of knowledge, there is only one remedy, and that is photography. It comes as a harmonizing mediator. Under some circumstances the picture is more valuable than the original object. If we give some one a microscopical preparation with the view to his examining some particular spot in it, for instance, a lymph vessel containing bacteria, we do not know whether he will find the right place in it, or if he does see it whether he will have selected proper focus or the best illumination, etc. Several observers can come to a conclusion very quickly by using the photograph, while the object can be accessible to only one person at a time. It is easy to point out the object; measure it with compasses, compare with other photographs similarly taken, whether of the same or of other specimens. In photography the microscopist exercises a powerful control over his own observations.

Microscopical drawings of specimens are rarely absolutely true to nature; they are prettier and appear with sharper lines and stronger shadows than the original, and, as happens not unfrequently, a sharper line or darker shadow in particular places may give the figure quite another signification. The drawing, further, is no clue to the value of the preparation, for even a badly prepared and in itself a doubtful specimen may be represented by a tiful and apparently convincing drawing. This is impossi-

ble with photographic illustrations, in which the shadows in the preparation form the picture itself, and in which, as it were, the microscopical object copies itself. It is therefore impossible to introduce the slightest improvement into the picture except through retouching.

The necessity of good specimens is apparent. If one publishes a photograph he frees himself from every subjective influence in representing his specimens, and places, to a certain extent, the result of his researches before his critics. He admits them to take a direct share in his observation, and the consciousness that the photograph of the result of his work will expose him to much wider criticism by the scientific world compels a microscopical worker to check the accuracy of his observations and to defer the publication of the result until he is certain of his facts. The general adoption of photography in micro work would, no doubt, prevent many immature publications.

The value of photography may be shown by its use in the various questions regarding infective diseases. Koch and Lewis* came to an understanding regarding the differences which are found in spirillum of relapsing fever through the publication of their respective photographs. Lewis examined Koch's photographs in Cohn's *Beiträge*, and came to the conclusion that the spirillum of Indian relapsing fever was thicker than the European organism. We should have had reported two different spirilla and, as Lewis pointed out, two kinds of relapsing fever produced by them but for publication of the Indian organism. In Lewis's photos the spirilla and blood corpuscles are surrounded by diffraction lines, an infallible sign that, compared with the amount of light, he had used too small a diaphragm hole in his work, and probably also in measuring the object. (Koch.) It is known that the narrower the diaphragm the broader and darker does the edge of the object appear, and if the light is intense, as where sunlight is used, the edge of the object will appear broad and dark from the number of surrounding diffraction lines. It is also well known that stained bacteria should not be illuminated, if the best results are desired, by a very wide opening and not by a narrow hole, but by diffused light, by means of which full advantage is taken of the effect of the stain and a perfectly sharp contour obtained. This at once shows how easily mistakes would have been overlooked if only the drawings had been made or possibly never seen at all. Koch has photographed specimens of this disease sent by Dr. Carter, of Bombay, and has proved it to be identical with the European.

Koch says: "Photography proved of great value in the description of Letzerich's plasma corpuscles, plasma balls, swarming with micrococci, etc., illustrating his work on the morphological

*The microscopic organisms found in the blood of man and animals. Calcutta, 1879.

differences of the schizomycetes, for when he had seen the photographs they showed the plasma balls, etc., to be ordinary zoöglæa colonies of micrococci which occur in isinglass jelly." Koch suggests, as an example of the inaccuracy of some observers, a comparison of Zurn's photographs of *bacillus anthracis* in Zurn's fig. 4. plate II, and figs. 2 and 4, on plate I, with his photograph, No. 6 (Cohn's Beiträge, bd. 2, hft. 3, plate XVI, Nos. 5 and 6), and if the comparison is made by any one who knows photography he will readily recognize that they are putrefactive bacilli. In describing this last photo Koch pointed out the danger of confounding it with other somewhat similar bacilli. He also referred to the researches on splenic fever and septicæmia (Koch). Semmer in Virchow's Archiv., bd. 70, S. 371, also gives an excellent example in his researches on pathogenic bacteria.

Do not think that photography is to take the place of drawing universally; that can never be, as there are many instances where photography is not possible.

[*To be continued.*]

The Microscope in Schools and Colleges.

By L. W. CHANEY, Jr.,

PROFESSOR OF BIOLOGY IN CARLETON COLLEGE, NORTHFIELD, MINN.

Ever since the discovery that vision of small objects could be secured by lenses, two uses have been made of the microscope. (1) In the hands of earnest men it has revealed wonders in the world of little things no less marvelous than the more imposing revelations of the telescope. (2) In the hands of amateurs desiring satisfying amusement it has served an admirable purpose. Some of the most important improvements in microscope construction have resulted from the enthusiastic devotion of those who entered upon the employment simply as a diversion. These two services rendered by the instrument have been so clearly evident that makers have been influenced by it in the styles which they have adopted and in the accessories produced. Only within a few years has the microscope assumed a place in instruction more important than that of any other instrument. The demands of instruction differ from those either of investigation or pleasure.

The investigator seeks new facts, the amateur the beautiful or remarkable in nature; the student needs confirmation and enforcement of the results already worked out. There is at present a considerable tendency toward insisting that the student shall be an investigator. Using the word student in a broad sense, however, it becomes evident that for general purposes of training much better results may be attained by repeating the work of some one under proper guidance than by trying at once to venture into

new and unknown provinces. The student must acquire dexterity and the power of seeing and describing what he sees. This done, he may pass on, if his aptitudes so suggest, into the work of investigation.

The different aims of these three classes, investigators, amateurs, and students, give rise to different demands, so far as equipment is concerned. Special appliances to secure special purposes will naturally appear in an outfit designed for discovery. The bacteriologist will surround himself with an array of ovens, culture tubes, and media which would be useless rubbish in an ordinary laboratory. The amateur may rightly insist upon beauty in his apparatus, and upon accessories whose only service is to make the microscopic image more beautiful and thus a greater delight to the eye and to the understanding. The student has limited time. He wishes to secure the utmost of discipline and acquirement by the use of that time. Simplicity must then be his watchword. No contrivance which does not serve an important purpose should be allowed to usurp the attention which ought to be directed through the outfit to results.

Methods are now being used with good results in some institutions where the appliances cannot be provided with unlimited liberality. Few colleges at the present time are likely to make the mistake, formerly too common, of expending a large sum upon one huge instrument encumbered with such a maze of wheels and levers and what not, as to require a preliminary training in applied mechanics to operate it. It is true, however, that a large number of instructors do not have confidence in the worth of the really admirable instruments both of foreign and American manufacture which may be purchased by institutions at about thirty dollars each. For students' use these instruments are all that can be asked, and might well be chosen even when expense was not a weighty consideration.

In my own laboratory eighteen students are provided for, with a possibility of arranging for thirty when it is demanded by large classes. The place of the microscope in the instruction given will best be understood by an outline of the biological work done by the scientific students during their course. Biological studies begin with the freshman year. The first term is devoted to general biology, using Sedgwick's and Wilson's work as a guide. Microscopical technique is given in connection with the study of protoplasm, cells and cell activities, and such other matters as are properly introductory in the line of instruction. It seems best carefully to avoid putting forward this technical acquisition as an end in itself, but the effort is to lead the student to a point of experience where he cannot proceed without appealing to the microscope for aid. On this plan the true relation of the instrument as a means to certain results is satisfactorily indicated, and

the student is saved from regarding it as a wonderful toy, and its use as principally an amusement. When it becomes necessary to make an accurate drawing of any object observed, the student is taught the structure and use of the camera lucida and the micrometer; when a structure is encountered which can be more clearly demonstrated by the polariscope, it is brought into requisition.

Prepared by this general use of the instrument, the student is next set to apply his skill to such microscopic problems as are presented by a typical animal and a typical plant. During the second term types of animal life are studied with microscopical technique somewhat more as a separate subject. The processes by which permanent preparations are produced are given, and the student prepares a series of mounts in which is involved most of the standard processes of hardening, staining, and section cutting. This fits him to continue the use of the instrument in any further lines of inquiry upon which he may wish to enter. The last term of the year is given to botany, the microscope being constantly used in the study of minute organography, and in a somewhat complete treatment of vegetable histology.

Later in the course choice is offered between further study of botany for two terms or a like time given to zoölogy. In this the microscope comes in especially to fill out the work upon minute organisms in both kingdoms. Biological study ends with human physiology and histology.

The limits of this paper do not permit anything more of detail than is given above. It is enough, however, to fortify the assertion that no other instrument bears so close a relation to scientific study at the present day. The biological departments are not alone in this. Chemical laboratories will shortly need, as part of their equipment, microscopes of peculiar construction adapted to some special purposes. Lithological study is already largely microscopical, and a vast literature is growing up bearing upon the study of rocks by this method.

No one can successfully teach the sciences without knowing and using the microscope, and no institution can long hope to maintain a reputation for scientific instruction without providing with some liberality this essential instrument for that instruction.

The McIntosh New Clinical Microscope is sold at from $20 to $32, and constitutes a good student microscope at very low price. Wales objectives and Gundlach objectives are catalogued in detail. Turn-tables, voice-pieces, diaphragms and an electric illuminator fill out the list. Send for a copy, addressing the Company at Chicago, Ill.

EDITOR'S DEPARTMENT

The Microscope.—The periodical bearing this name was started eleven years ago (in April, 1881), at Ann Arbor, Mich., by Dr. and Mrs. C. H. Stowell, who entered into a vigorous competition with *The American Monthly Microscopical Journal*, which had been previously established by Prof. Romyn Hitchcock. The latter replied with scathing criticisms, some just and some apparently unjust. The most intense rivalry was created, and, although apparently losing money, for five years the contest went on, neither being willing to yield the field. But in August, 1886, the ill-health of Mrs. Stowell was announced, and *The Microscope* was transferred to Detroit, where a board of four editors assumed control. At about the same time, Prof. Hitchcock was invited by Prof. Todd to become a member of the eclipse party which was going to Japan, and he accepted. Both periodicals were now in new hands, and the era of hostility closed.

Had the competition been free from ill-feeling, it is likely that one of the two periodicals would have died out in a few months, for there never has been standing room for both, and the net profits of neither have ever been worth mentioning. At no time have the two combined ever had 3,000 subscribers, and yet either one could always have had a paying existence if it could have controlled the field.

It is an interesting incident that Dr. Stowell, since parting with *The Microscope*, has come to Washington to live, and the very month in which the magazine he founded has found its way to the same city (March, 1892), he has started a new medical journal called *The National Medical Review*, to which his old microscopical friends will doubtless want to subscribe, the price being only one dollar per annum. Mrs. Stowell is one of the microscopists in the Agricultural Department, and Prof. Hitchcock is also here, having just returned from a two-years' trip to China.

To run *The Microscope* as well as it has been run was found, first by the Detroit people and next by the Trenton people, not to be a paying investment. Had they been willing to yield the highest place to the older journal, they might have occupied the amateur field, but this they would not do; nor would *The Journal* surrender the field which it had by the right of preoccupation. To Dr. Stokes and the writer is due the credit of bringing about,

through friendly competition, a better state of affairs, and finally a discontinuance of wasteful competition.

It is greatly to his credit that he was willing to let *The Microscope* drop from the place it never ought to have tried to take, and to permit the writer to make such reorganization as in his judgment the circumstances demand.

The Journal, being the elder, has the right, outside of all personal considerations, to become the foremost microscopical periodical of America, and such we trust is its destiny. But the patronage is so small that a subscription price of two dollars is necessary, and all microscopists should frown down every attempt of ambitious persons to enter the field of competition until after there is room for a new periodical. Besides the few hundred Americans who want a high-grade microscopical periodical, there are about as many more who have no use for a strictly scientific journal, but who want strictly elementary matter. The advanced workers are not willing that their journal shall be made a vehicle for elementary matter, and the amateurs will not pay two or more dollars for a magazine combining everything. Hence consolidation seems impracticable. Were it attempted, a new dollar periodical would shortly spring up, first appealing to amateurs, but gradually working its way towards competition with the older journal. The history of the past twelve years would be repeated.

The Microscope will therefore take the elementary field as a dollar magazine, and be used as educative and preparatory to *The Journal*. It will presume its readers to be but little acquainted with the subject, and writers who can satisfy such people will be engaged. A large query department will be maintained, and the simplest questions as well as the abstruse will be answered. This department has already been tendered to a well-known writer, Dr. S. G. Shanks, of Albany, N. Y. We shall seek to supply every want of the beginner in microscopy, and try to induce many people to begin this fascinating occupation.

Perhaps some people have paid for *The Microscope* of 1892 in the desire to have more technical articles than will hereafter be found in it. If such persons desire to return the numbers which they have received and get their money back they can do so, or they can have the address changed to some other person to whom they wish to present the periodical, in which case we will notify the recipient to whom he is indebted for the present. We regret that this change of policy could not have taken place
he beginning of a volume, but this was unavoidable. Dr.
had hoped, until within a few weeks, to go through the
erwork, however, has compelled him to seek relief and
on in a trip 3,000 miles from home. On his return we
rust that he will be heard from often by those who
ed his labors in the past.

We have explained the situation sufficiently to show why the size of the *Microscope* must be reduced to a paying basis. This will mean from 12 to 20 pages monthly, according to circumstances, and be influenced by the number of subscriptions which we can get, old and new. While the price will remain at one dollar, those who pay two dollars for *The Journal* will get the *Microscope* for one-half dollar additional. By scattering sample copies freely, it is hoped to attract to the subject many physicians and teachers who have heretofore let the subject go unnoticed.

Finally, who shall edit the *Microscope* on the basis now described? The matter is under consideration. But who do you prefer? We shall be pleased to receive a postal card from every one who expects to take a copy, announcing his or her ballot for editor. Who do you vote for? Vote early, and in this case there will be no harm if you vote often.

At last we may congratulate American microscopists that after eleven years of ruinous rivalry and migration, during which time both periodicals have been kept at starvation prices, the time has come for a union of effort, of desire, and of interests.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

1. *Cole's Microscopical Series. Where can they be had? How can I see a sample?—W. H. Saunders, M. D.*

Address J. W. Queen & Co., Philadelphia, for a list of Cole's preparations.

Does any reader know where Cole's studies may be had?

2. *Sections of Meteoric Stones. Can you inform me if such preparations are for sale? An undoubted slide of this kind is desired.—Henry W. Lothrop.*

W. Watson & Sons, No. 313 High Holborn, W. C., London, Eng., lists a slide of meteoric stones at 3*s.* 6*d.*

A. E. Foote, Minerals, Philadelphia, can supply meteoric iron in the mass.

3. *The American Postal Microscopical Club. Can an isolated amateur join, and what is the fee?—Dr. Liggitt.*

The managers desire a moderate, permanent, and intelligent membership, rather than a large number of more or less indifferent or careless persons whose heedlessness cause annoyance and loss to the Club. An isolated lover of the microscope may be

accepted and assigned to a contiguous circuit. The annual dues are one dollar and a good microscopical preparation for Club use. Address R. H. Ward, M. D., No. 53 Fourth st., Troy, N. Y.

4. *How to treat the diatomaceous material sent out by the Microscopical Journal ?—Many Subscribers.*

1. Boil the material in clear filtered water, let it cool and settle. Carefully pour away the surplus water, add fresh, and boil again. Repeat this boiling and washing until the water remains clear; finally decant the water, leaving the diatoms as dry as possible.

2. Add half a drachm of strong nitric acid, boil thoroughly, drop a small crystal of bichromate of potash into the hot acid, boil again for several minutes. Add clean water and allow it to settle; pour away this acid water, add fresh, and repeat this washing until the water remains clear and neutral.

3. Add a piece of clean soap, about the size of a pea, and a little water to the diatoms, boil thoroughly, add fresh water, and allow plenty of time for the smaller diatoms to sink through this thick liquid; pour off the soapy water, and continue the washing until the water is absolutely clean.

Examine a minute quantity of the material with the microscope; if the shells are not clean and bright begin again with the nitric acid and bichromate and follow with the soap as before. Use a four-inch test tube and a lamp of any kind. When boiling have about half a teaspoonful of fluid in the tube; when washing fill the tube with clean water. Revolve the test tube sharply between the fingers at times during the process of settling, to detach diatoms adhering to the sides of the glass tube. Do not hurry the boiling or the settling processes. Pour off the wash water very slowly so as not to disturb the deposit in the bottom of the test tube. Keep the cleaned diatoms in a small vial of clean water.

5. *Where can I get a slide of volvox globator ?—Amateur.*

Various dealers report themselves out of volvox at present. I. Percy Blackman, of Sandy Hook, Conn., used to have slides and promises some more the coming July or August. Write to him.

6. *A solitary amateur in Silver City, N. Mex., wishes to know how he can work up his enthusiasm, provide himself with slides, and keep in touch with kindred spirits ?—J. H.*

Take all the microscopical journals and have Carpenter, Stokes, and White in your library. Learn to prepare mounts. Walter White's vegetable preparations (advertised in the *Journal*) are beautifully stained sections, usefully mounted, but may be easily remounted on glass slips. The large dealers keep packages of unmounted objects—insect dissections, hairs,

miscellaneous objects, etc., with directions for mounting them. A dozen or more good mounts should be bought to serve as models. When neat mounts can be produced offer them for exchange to the persons using the Exchange column. The American Microscopical Club, Troy, N. Y., receives suitable persons desiring continuous membership. The Club circulates for examination about 60 mounted objects, of wide diversity, each season, with note-books containing a description of the preparations, methods of mounting, and notes and comments by the members. An attentive membership in the Club is a liberal microscopical education. The Club year begins about October 1st; an early application should be made.

7. *The Cole Studies. What are they and how shall I get them?—A Subscriber.*

Studies in microscopical science, issued by Arthur C. Cole, consisted of a series of animal, vegetable, and mineral mounts, accompanied by a full letter-press description, with lithographed plates of each preparation. They were necessarily rather costly, and their limited circulation was attended with pecuniary loss. Their publication has been discontinued. American dealers may still have some sets, or the author may be addressed: Mr. Arthur C. Cole, St. Domingo House, Oxford Gardens, Notting-Hill, London, W., England.

8. *Gold Crystals. How are they made?—S. W. C.*

Use a strong solution of pure chloride of gold. Make a pool of it in the centre of a glass slip. Cut a piece of zinc in the form of a long triangle, bend this so the apex will reach to the centre of the pool of gold solution, the base resting on the glass. Crystals will radiate from the zinc in the centre of the pool. Wash carefully with distilled water. When dry, cover.

9. *Diatoms and waste matter of the same specific gravity. How can they be separated after using caustic potash to break down the earth?—P. Q.*

Caustic potash corrodes silex and should not be used on diatoms. Boil the material in water until broken down. Then boil with nitric acid, and nitric acid and a crystal of bicromate of potash; wash; boil in water with a morsel of soap; wash. Repeat all processes again if the diatoms are not clean and bright. Sand may be more or less completely removed by rotary washing in a watch-glass, manipulating the glass so as to throw the rolling sand to the edge, where it may be easily removed. This is a tedious process, but there is no other way, except to pick the diatoms out with a mechanical finger.

10. *Frustules of diatoms. How can they be rendered transparent in balsam?—E. D. C.*

Diatoms on algæ should be well soaked in absolute alcohol; transferred quickly to oil of cloves; when transparent the surplus oil removed with blotting-paper, then into balsam as usual. If air is still present, gently heat the mount until the balsam boils, adding more balsam if necessary, so it will be drawn under the edge of the cover.

11. *Animal Parasites. How can they be preserved until mounted?—L. M. Mooers.*

If intended for balsam, preserve in alcohol. If for glycerine or Farrant's solution, use equal parts of glycerine, alcohol, and water. Parasites preserved in the latter solution may be mounted in balsam if the glycerine is removed by prolonged soaking in water, then into alcohol.

12. *Starch. What is a good method for mounting starch? —C. W.*

Place a minute drop of oil of cloves on the centre of the slip; drop in the starch, separating lumps; remove any excess of oil with blotting-paper; apply a drop of balsam; cover; use a gentle heat, allowing the cover to settle by its own weight. If the starch is observed to mass at one side apply a gentle pressure with a mounting needle on the cover over the mass to aid in distributing the starch uniformly.

13. *Cohering Slides. What can be done to save some slides that were carelessly placed together and have stuck fast?— W. S.*

Apply a gentle heat and carefully insert a thin knife blade between the mounts and so separate them.

14. *What is "concentrated strupous glycerine," mentioned on page 67, A. M. M. J., 1892?—S. W. Jackson.*

It should be "concentrated syrupy glycerine."

15. *Histological and pathological slides. Where can I buy reliable preparations ?— W. R. Shinn, M. D.*

See our advertising columns for notices of preparations of such mounts.

16. *Barbadoes Earth. Where can I obtain a lump of this material?—John Halle.*

Can any reader furnish the desired information?

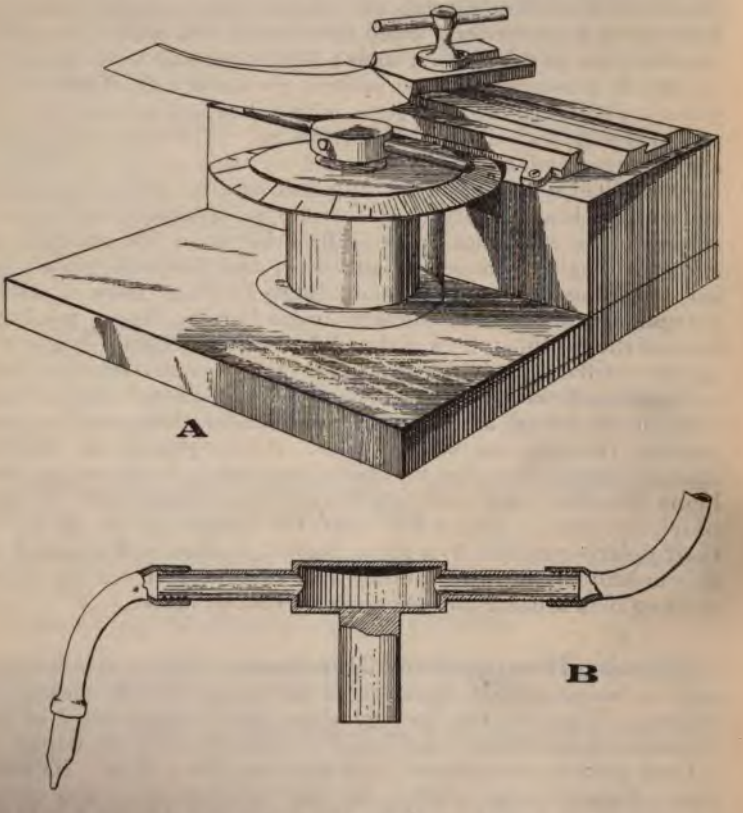
NEWS · FROM · THE · WORKERS ·

A Polarizing Object.—Professor E. B. Knerr of the Midland College, Kansas, sends us the following: A beautiful polarizing object for the microscope is made of the needle-shaped crystals usually found on the surface of vanilla beans. To get the best effect, a few of these crystals are dropped upon a cover-glass and held in the fingers over a lamp flame until they melt. By holding the glass in the fingers, such a heat as would decompose the crystals is prevented. When molten, the under side of the cover-glass is moistened near the edge with saliva and placed upon an ordinary slip, with the molten crystals up. The saliva causes the cover-glass to adhere to the slip, and the body of the instrument may be tilted without danger of its falling off. The preparation is examined immediately. At first no polarization will appear, even after the substance has solidified, but in a few seconds an edge will begin to show brilliant color, and this will grow rapidly until the whole patch is exceedingly brilliant, showing at the margins fine flame-like structures much like the figures we have seen of the protuberances of the sun's corona. Should any of the patches of the material be slow to take up the polarizing structure, a slight touch with a needle or even a sudden blow on the table will induce action, and when once started the change will spread rapidly through the whole mass. Cover-glasses are recommended rather than slips to receive the crystals, for the reason that being thin they cool very rapidly and the experiment requires much less time. After a few hours the crystals on the glass lose their polarizing effect to a great degree, especially if exposed to the moisture of the air, but they can soon be restored by again melting over a flame and allowing to cool as before.

Cleaning Homogeneous Objectives.—After one is through with a homogeneous objective, it should be carefully cleaned as follows: Wipe off the homogeneous liquid with a piece of the Japanese paper, then, if the liquid is cedar oil, wet one corner of a fresh piece in benzine and wipe the front lens with it. Immediately afterward wipe with a dry part of the paper. The cover-glass of the preparation can be cleaned in the same way. If the homogeneous liquid is a glycerine mixture proceed as above, but nse water instead of benzine to remove the last traces.—*S. H. Gage.*

WAYS AND MEANS

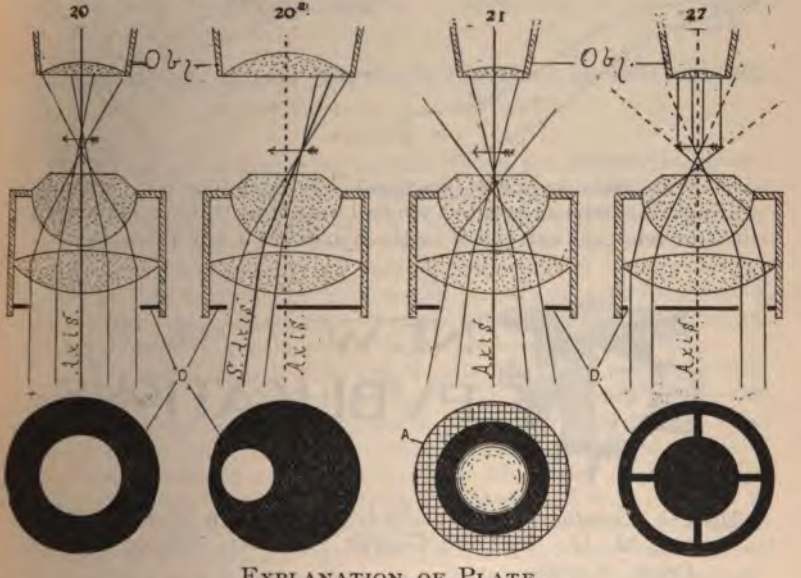
Taylor's Freezing Microtome.—The instrument is of metal, screwed to a block of polished mahogany. There is a revolving table with graduated margin, in the centre of which is fitted a freezing-box having two projecting tubes, one to admit



freezing water, the other an outlet for it. The water is supplied from the reservoir and carried off by means of rubber tubing

which is attached to the metal tubes, the terminal end of the outlet tube being furnished with a small glass tube by means of which a too rapid outflow of water is prevented. The tubes of the freezing-box are so arranged as to prevent their revolving with the revolutions of the table. In B is shown a sectional view of the freezing arrangement.—*American Monthly Microscopical Journal, February, 1892.*

The Abbe Illuminator or Condenser.—For all powers, but especially for high-power objectives, a condenser or illuminator is of great advantage. The one most generally useful was designed by Abbe. It consists of two or three very large lenses which are placed in some form of mounting beneath the stage. It serves to concentrate a very wide pencil of light from the mirror upon the object. For the best work in modern histology the Abbe illuminator is almost as indispensable as the homogeneous immersion objectives.



Explanation of Plate.

Fig. 20, 20a, 21, and 22. Sectional views of the Abbe Illuminator of 1.20 N. A., showing various methods of illumination. Fig. 20, axial light with parallel rays. Fig. 20a, oblique light. Fig. 21, axial light with converging beam. Fig. 22, dark-ground illumination with a central stop diaphragm.

Axis. The optic axis of the illuminator and of the microscope. The illuminator is centred, that is its optic axis is a prolongation of the optic axis of the microscope.

S. Axis. Secondary axis. In oblique light the central ray passes along a secondary axis of the illuminator, and is therefore oblique to the principal axis.

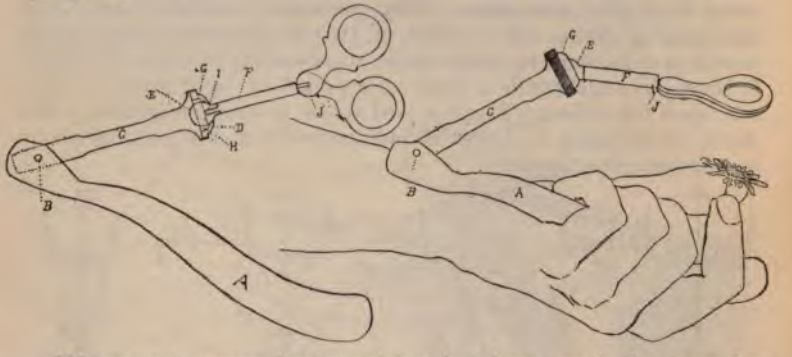
A, Fig. 21 represents the upper part of the illuminator.

D D. *Diaphragms.* These are placed in sectional and in face views. The diaphragm is placed between the mirror and the illuminator. In Fig. 20 the opening is eccentric for oblique light, and in Fig. 22 the opening is a narrow band, the central part being stopped out, and thus giving rise to dark-ground illumination.

Obj. Obj. The front of the objective.

For further illustrations of this apparatus and its use we refer the readers to Professor S. H. Gage's new work, entitled "The Microscope and Histology," to which we are indebted for the above.—*American Monthly Microscopical Journal for April.*

Prof. Sayre's New Pocket Microscope.—In the *Microscopical Journal* for April will be found a full description of this ingenious device for holding a flower and the lens in one hand while having the other free to use for dissecting or for any other purpose.



We are not aware that provision has been made for manufacturing this lens as yet, but we feel sure that "there is money in it" for whoever can put it in the market at a low price.

NEW PUBLICATIONS

Modern Treatment of Headaches. By Allan McLane Hamilton, M. D. Detroit: George S. Davis. 16mo, pp. 122. Price, 25 cents.

In a very pleasing way the author treats *in extenso* of headaches in general—of congestive, anæmic, organic (due to structural changes within the brain), toxic (lithæmic, uræmic, malarial, etc.), neuralgic and neurasthenic headaches. Much valuable information has here been compressed into a small space, but without giving undue prominence to any one form. The author pecial attention to the treatment, and has succeeded in pre- ne of the most important volumes that have recently ap- the "Physicians' Leisure Library."—*A. C. S.*

·THE·MICROSCOPE·

AN ILLUSTRATED MONTHLY MAGAZINE.

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On Imbedding Animal Tissues in Paraffine for Sectionizing.

BY PROF. H. L. OSBORN,
HAMLINE, MINN.

This method of preparing animal tissues for sectionizing is described in all books of microscopical technique, and the description presented here merely repeats from them without adding any specially new features. Since every detail in this connection is important, I will risk being tedious and attempt to give an account by following which anyone can be sure of success. Every step of the process must receive careful attention to insure success. The work can conveniently be subdivided into several parts.

1. **Fixing or Hardening the Tissue.**—One of the best modes of hardening is by the picro-nitric acid method. Prepare the hardening fluid as follows: Dissolve picric acid crystals in distilled water to saturation, add 2 per cent. of strong nitric acid; a heavy precipitate will fall; filter and keep the filtrate for standard solution. Place in this standard solution, weakened with one-half or two-thirds water, a piece of perfectly fresh tissue from a just killed animal, or for small animals immerse the entire creature. Leave it in from 3 to 6 hours. Then transfer it to 30 per cent. alcohol, and in a few minutes thence to 50 per cent., and after an hour to 70 per cent. Keep it in 70 per cent., changing the alcohol daily till no yellow color is imparted to the alcohol by the specimen. It is then ready for staining.

2. **Staining.**—Prepare a solution of borax carmine as follows: Carmine, 1 gramme; borax, 4 grammes; distilled water, 56 c.c. To this solution add its volume of 70 per cent. alcohol and filter. The solution thus made will keep indefinitely. Immerse the specimen after completion of hardening in the borax carmine solution,

and leave it 24 hours. It will then be evenly stained (provided the acid of the picric has been perfectly removed by alcohol washing). To wash out over stain of borax carmine, immerse the specimen for a few minutes in 70 per cent. alcohol, to which 2 per cent. hydrochloric acid has been added, and in renewed washes as long as color is removed by the washing fluid. Then place in a considerable amount (20 vols.) of 95 per cent. alcohol, and finally in absolute, and leave for several hours. At this step great care is needed for the paraffine imbedding imperatively requires the entire removal of water from the tissue.

3. **Imbedding.**—After the water has been removed, the specimen is to be placed in spirits of turpentine and left there until it becomes very translucent, all the alcohol being replaced (or chloroform can be used equally well or, perhaps, better than turpentine) after a period of twelve hours for a piece the size of a one-half inch on a side, the specimen is transferred to a mixture of turpentine (or chloroform) and paraffine which is fluid but nearly saturated. Here it stays another period of twelve hours, when it is ready for its final bath in pure paraffine. A too hard paraffine will interfere with the operation of the razor in section cutting. The paraffine must be kept melted at a temperature of 66° C. and positively must not rise to 70° C. A water bath is needed for the purpose. The specimen should remain several hours in this bath till all trace of the turpentine is gone by evaporation. Then the specimen can be removed and moulded in a block of paraffine. If this process is wholly successful, the specimens will keep indefinitely. I have some now which are 8 years old and good yet, and sections can be cut out at any time.

4. **Section Cutting.**—In sectionizing, the specimens should be cut with a direct and not a sliding movement of the razor; the temperature of the room should be just right and the razor sharpened just to the right degree and its movement at the proper speed; a slice of almost any thinness can then be cut. But all of these requirements must be carefully fulfilled or exasperating failures are likely to occur. After the sections are obtained they should be cemented to the slide. The white of egg method is very easy of application. Spread a thin even film of white of egg on the slide and lay the section upon it. Heat gently over a lamp until the paraffine melts; this coagulates the albumen. Then set aside until the albumen has hardened. Then cover the specimen copiously with turpentine and dissolve the paraffine; remove the superfluous turpentine and add Canada balsam in benzine or chloroform, cover, and the section will be ready for udy. The sections from which the study of *Lumbricus* were d were made by this method, and though it is extremely it gives the most satisfactory results.

The Value of Photography to the Microscopist.—II.

By V. A. LATHAM, F. R. M. S.

ANN ARBOR, MICH.

[*Continued from page 100.*]

The illumination used in photography must be similar to that used for eye examination. If diatom markings show best with direct sunlight and oblique illumination, then they will be most accurately photographed under the same circumstances. To obtain the best results three conditions at least must be fulfilled: (i) Those parts of the specimen which it is desired should stand out markedly in the picture, such, for instance, as bacteria, cell nuclei, etc., must be stained as deeply as possible with a color which absorbs the blue rays, and therefore acts on the sensitive plate just like black colors, which absorb the light; yellow and brown dyes are therefore the best. To determine the suitableness of the stain is to look at the stained preparation in monochromatic blue light, such, for example, as may be obtained by passing the light through a solution of ammonia sulphate of copper, under which condition the cell nuclei, bacteria, etc., should appear as more or less black bodies on a blue ground. (ii) High power photography can best, and indeed only, be obtained with sunlight, though admitting it directly on the object to be photographed is disadvantageous, and it therefore must be diffused by the interposition of one or more plates of ground glass.

(iii) The third condition is an illuminating condenser of such construction that the dispersed sunlight brightly illuminates the object from all sides and prevents the appearance of the structure picture or of diffraction lines. No one would suspect that in these conditions there are special methods of manipulation by means of which it is possible to represent by photography more than what actually exists. Touching up the negative of prints should on no account be done, as it destroys their value. As many retouched micro-photographs are published, it is necessary to be aware of the fact, and to discount them accordingly. The stains usually adopted are considered the best in the order given: Bismark brown, vesuvin or Friedländer's ammonia carmine or Piersol's modification of Schultze's stain for the nervous system, chrysoidin, logwood, methyl blue, Spiller's purple, fuchsin. Carbutt's blue label plates are some of the best for this work. He has so improved his orthochromatic plates that no color screen is required. In illumination for photography and microscopy the *light must be kept* in the direct line of the apparatus, and it is well to draw the centre on the ground-glass focussing screen by drawing two diagonals from the four corners, and the lines at intersection is the focal point. The best media to mount specimens in for photography stand perhaps in the following order, but I have

used Canada balsam, making it myself so as to get a white sample without any trouble: a saturated solution of acetate of potash, glycerine and dammar varnish, and Canada balsam.

It is to be greatly deplored that the papers, books, and discussions on photography should give the uninitiated the idea that it is a very complicated and difficult art, dependent upon daylight, and that unless a person had the necessary time during the day and was an expert in photography it would be useless to attempt the application of the art. As is known to many, any microscopist, armed with a small text-book and with a simple apparatus which he can even make himself, can after a little practice produce faithful pictures. Of course there *are* difficulties and indeed always will be, but as many have to be encountered elsewhere than in photography. A beginning has to be made somewhere, and the tyro's first efforts may as usefully and with as great hope of ultimate success be directed to this branch of learning as to any other. It is a matter of certainty that his first attempt will be failure from under-exposure, fog, frills, stains, etc., but with landscapes this would possibly have been the same. We all know that general photography had better be acquired when possible. As regards the books suitable for work in this line it is a difficult thing to select, for thus far I have not seen a book which can safely be placed in the hands of an amateur. Even if great care is used the chances are that he will not succeed, simply because here and there a necessary point has been ignored, too simple, so the author thought, to be printed. When a book for amateurs is written the process should be carried out at the *same* time, and then let the method be tried by an amateur. I will mention several works which may be useful to amateurs: A pamphlet by Mr. Stanley, Optician, London Bridge, England, which is worthy of beginners; a chapter in G. E. Davis's Practical Microscopy, 1st ed., pp. 207–228; Beale's How to Work with the Microscope, 4th ed., Part IV, p. 229, and the Bibliography at the end of the book; Micro-Photographs and How to Make Them, by J. H. Jennings, 3*s*., published in England; a paper in the International J. of Microscopy, Aug., 1891, by Vereker; a pamphlet by the Blair Camera Co. on Photography; a good text-book of photography is Abney's "Instruction in Photography" (Piper & Carter); Photography Applied to the Microscope, F. W. Mills and I. C. White; Dental Cosmos, vol. 8, p. 248; Micro-Photographs and a New Method to Make Them; Sternberg's Micro-Photographs is good, but is perhaps scarcely up to date; Malley, A. C., Photo-Micrography, 2d ed.; Bousfield, E. C., a small work on Photo-Micrography; Crookshank, E., Photography of Bacteria; this is nearly out of print, and is a practical work, but a revision to bring it up to date is now for those who wish for the Micro-Photographs in

Histology, Seiler's (C.) work is good, and Fraenkel & Pfeiffer's Micro-photographic Atlas of Bacteria, Berlin.

I do not think Andrew Pringle's work at all adapted for beginners, or even for moderately advanced students, as is so often recommended, the apparatus and methods being too extensive. For advanced workers it is a valuable work.

If any readers of this article will give aid by criticisms of good works, noting their good points, there might be a good deal learnt and much assistance rendered to all students of microscopy.

The Care of a Microscope.

By EDWARD BAUSCH,
ROCHESTER, N. Y.

[From *Manipulation of the Microscope*, pp. 107-9.]

Besides acquiring the ability to properly use an instrument with its accessories, it is important to know how to keep one in the best working condition. It may be said without reserve that an instrument properly made at the outset and judiciously used should hardly show any signs of wear either in appearance or in its working parts even after the most protracted use; and further than this, every good instrument should have a provision for taking up lost motion, if there is a likelihood that this may occur in any of the parts.

Especial care should be given to the optical parts, in fact, such care that they will remain in as good condition as when first received. Accidental injury may of course occur to them, but if a systematic manner of working is followed and a special receptacle for each part is provided this may usually be avoided. The following rules refer mainly to the instruments manufactured by the Bausch & Lomb Optical Co., but are applicable to instruments in general.

To Take Care of a Stand.—One of the first rules should be to keep the instrument *free from dust*. If dust settles on any part of the instrument, remove it first with a camel's-hair brush, and then wipe carefully with a chamois skin, *with* the grain of the finish and not across it, as in the latter case it is likely to cause scratches. Keep the working and sliding parts absolutely free from dust, as this grinds and will thus soon cause play.

Use no alcohol on any part of the instrument, as it will remove the lacquer. As the latter is for the purpose of preventing oxidation of the metals, it is important to observe this rule.

In using the draw-tube impart a spiral motion. In instruments which have no cloth lining, a straight up-and-down movement should be employed, as the tube will otherwise become scratched. If it becomes necessary to lubricate any of the parts, use a slight quantity of soft tallow or good clock oil.

In an instrument which is in constant use it sometimes occurs

that the pinion works loose, and occasionally to such an extent that the body drops of its own weight. Tightening screws are provided to take up the play. In the Professional, American Concentric, Universal, Physician, Biological, and Library microscopes these are in the back of the pinion. In the Investigator, Model, and Family microscopes, they are seen in the slide by removing the body.

In using a screw-driver, grind its two large surfaces so that they are parallel and not wedge-like shape, and so it will exactly fit in the slot of the screw-head.

In inclining the stand *always* grasp it at the arm and *never* at the tube, as in the latter case it may loosen the slide or tear off some of the parts.

When repairs or alterations are necessary, always have these made by the manufacturers; they can, from the system of duplicated parts, not only do it cheapest, but best.

To take Care of Objectives and Eye-Pieces.—It is as necessary to keep these *free from dust* as the stand, in fact even greater cleanliness should be observed. When indistinct, dark specks show in the field, the cause may usually be looked for in the field-lens, although sometimes in the eye-lens also. The dust may be removed by a camel's-hair brush, but when this is not sufficient use a well-washed piece of linen, such as an old, old handkerchief. From its fine texture chamois skin is desirable, but as it is fatty it should never be used until after it has been well washed.

The same method applies to cleaning objectives. Clean an immersion objective invariably after it has been used, first by removing the fluid by a moist linen, and then by using a dry piece. Keep the objectives especially in a place where they are not subject to extreme and sudden changes of temperature, as the unequal expansion and contraction of glass and metal may cause the cement between the lenses to crack. Also keep them from direct sunlight.

Screw them into the nose-piece and unscrew by grasping the milled edge.

Avoid any violent contact of the front lens with the cover-glass. Usually the latter suffers, but it is as liable to occur to the former.

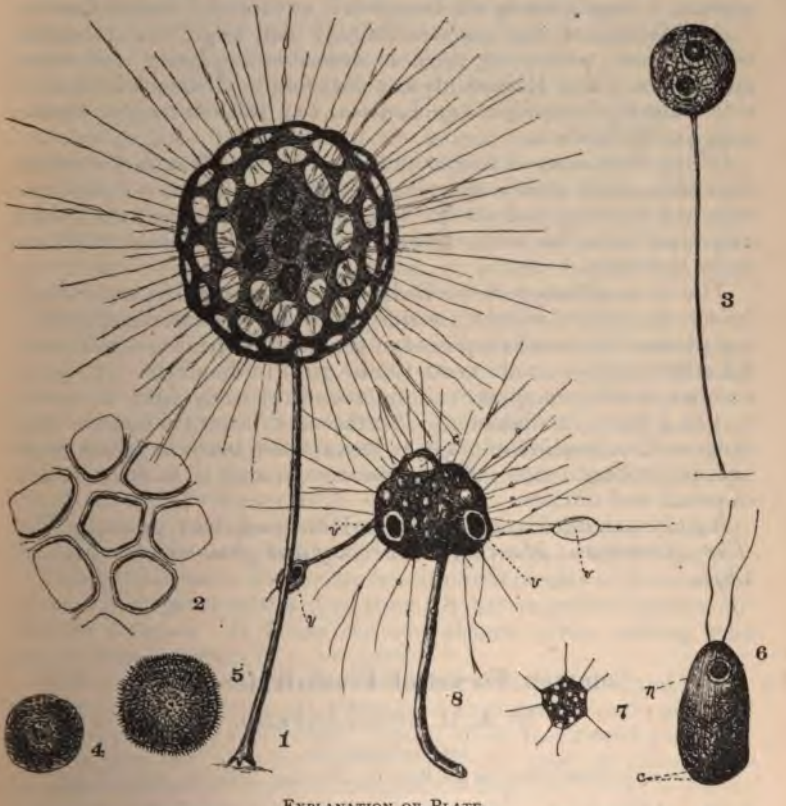
Above all, it should be made a rule that no one but the owner handle the microscope and accessories. One person may be expert in the manipulation of one instrument and still find it difficult to work with another.

[illegible]e fine adjustment particularly causes the greatest difficulty,
[illegible] instruments it corresponds with the movement of the
[illegible]crew, while in others it is contrary, and thus the ob-
[illegible]as object are endangered.

A Beautiful Rhizopod—Clathrulina elegans.

By CHAS. W. SMILEY,
WASHINGTON, D. C.

At the lowest point in the animal kingdom stand the protozoa. Of these there are four classes: I, the Monera (without any organs); II, the Rhizopoda (having a nucleus and outer layer of sarcode); III, the Gregarinida (an ovate, animal parasite); and IV, the Infusoria (having a definite shape and usually one or more mouths), holding the highest place in the quartette.



EXPLANATION OF PLATE.

FIG. 1.—*Clathrulina Elegans*, x 350.
FIG. 2.—Enlargement (600 dia.) to show grooving of the outer surface of the latticed shell.
FIG. 3.—An individual in which the products of the simple fission of the protoplasmic body have become encysted.
FIG. 4.—A product of fission with pseudopodia withdrawn, globular, preparatory to encystment (x 320.)
FIG. 5.—A cyst covered with minute siliceous spinelets (x 600).
FIG. 6.—A zoospore with 2 flagella, nucleus (*n*) and 2 contractile vesicles (*c*).
FIG. 7.—A flagelulla which has lost its shape and become an amœbula.
FIG. 8.—A young specimen which has a stalk (*x*) but no shell yet, food vacuoles (*v v*) and contractile vesicle (*c*).

The Rhizopods are rarely visible to the naked eye, but they abound everywhere if there is moisture or dampness—in ponds, in lakes, in swamps, in sea, in ocean. Some grow in salt water and some in fresh. Leidy has written only upon the fresh-water forms. Ponds and ditches may be skimmed for specimens with a small tin dipper, and the superficial ooze transferred to a bottle to await examination. Often specimens may be scraped up from wet ground with the blade of a knife, their presence being betrayed by the green algous material which is plainly visible. Their pursuit is feasible at nearly all times of the year, even in winter, if vegetation is not completely covered by ice and snow.

At this time of year our readers may well begin the collection of specimens, preserving them as described by Leidy and other authorities. The Rhizopods are classified by Hitchcock (Riverside Natural History) in (1) Lobosa, (2) Radiolaria, (3) Heliozoa, (4) Reticularia.

Of the Heliozoa, or sun animalcules, he says that they are very beautiful, being mostly spherical and floating forms. A few are attached by long pedestals. They put out delicate rays in all directions from the centre, often exceeding the diameter of the body in length.

The most common of the Heliozoa is *Actinophrys sol*, which occurs in pools of standing water almost everywhere among floating plants. Under a low power of the microscope it is a colorless, spherical body, 4-100ths to 12-100ths mm. in diameter. The great number of delicate spines can be seen projecting from the body to 3 or 4 times its diameter. But the most beautiful form of this order is *Clathrulina elegans*. Its capsules become yellow with age, presenting a rich golden appearance, and it is often found in ponds and ditches.

A quite extended account of this Rhizopod was published in *The American Monthly Microscopical Journal* for March, 1892.

Common Forms of Fresh-Water Algæ.

By A. H. BRECKENFELD,

SAN FRANCISCO, CAL.

[Abstract of a paper read at the San Francisco Microscopical Society, March 2, 1892.]

The Algæ form one of the subdivisions of cryptogamous or flowerless plants. They are all cellular, not vascular, and generally of a green color, though a few are brown or brownish-yellow. In point of structure the forms present considerable diversity, some being unicellular, some filamentous or thread-like, and some branching. While all are undoubtedly vegetable forms,

many in some stages of their development present motile forms endowed with such rapid motion that by the earlier observers they were considered animals. Other forms constantly present a motion of an oscillating or weaving nature that is absolutely inexplicable to scientists, as are also the apparently intelligent movements of the diatoms.

Our knowledge of the Algæ is so incomplete that the matter of classification is very difficult. One quite satisfactory division makes seven orders, viz:

Cyanophyceæ.—Including the well-known *nostoc* and the various forms of *oscillaria*, a form which propagates by cell division, and which is often found in hot springs possessing a temperature of 115 deg. Fahrenheit.

Protococcaceæ.—The best-known species being the protococcus nivalis, or *red snow*, often found in Arctic regions.

Conjugatæ.—This is one of the largest and most thoroughly studied of the orders, and includes the diatoms. Desmids and many filamentous forms, all, however, presenting this peculiarity, inferred in the name, that the union of the contents of two separate and distinct cells is necessary for the production of the zygospores or "winter" cells, the form in which the life is maintained through the season when growth is impossible.

Volvocaceæ.—The *volvox globator*, the most prominent species of this order, is perhaps the most beautiful and interesting of all the Algæ, exhibiting, as it does, a transparent ciliated globe, rolling about with a dignified motion and containing within many zygospores and zoöspores, which, upon the bursting of the parent envelop, sail away as free individuals. This species was found a few months ago in Mountain Lake by G. O. Mitchell, one of the members.

Siphoneæ.—This order presents but few fresh-water species, the rare *vaucheria* being found in several pools in the Presidio.

Confervoideæ.—This order is composed largely of filamentous forms which grow attached to stones, other vegetable matter, or even to animals. It forms the unwelcome green coating that forms upon the glass in our aquaria.

Floridiæ.—This last order is the most seldom found, and is represented by two species. It differs from the other forms in general, being of a red or purple color, instead of the traditional green.

After thus outlining the classification, the essayist gave a detailed account of the forms of conjugation displayed by *Spirogyra*, and traced the life-history of this form. The value of this class of plants in the economy of nature is incalculable. Presenting to the eye, as many do, the appearance of a mass of green slime, they are, under the influence of the sun's rays, the most active purifiers of the water, evolving large quantities of oxygen to burn up the dead animal matter and to give support to the living.

[The paper called forth many questions, and Mr. Breckenfeld was kept busy for some time in answering them, and then proceeded to explain the many specimens he had under the microscopes belonging to the Society or loaned by friends illustrating his paper.]

Popularizing Science.—One of our most esteemed contemporaries utters in his March editorial some comments upon the lack of appreciation of science which is shown by the public. He says that a dance or a dinner party is a most successful rival of a meeting of a society devoted to the pursuit of science or philosophy. "Where the heels or the stomach have the call, the brain has to retire into innocuous desuetude." We take no exception to his statement of the case, but we have a suggestion to make as to why it is so, and how to combat the situation.

People who can appreciate a dance or a dinner attend it; those who can appreciate science cultivate it. In order that people may appreciate dancing there are evening schools provided in which the novice may actually enjoy the drill by means of which he becomes expert. Where has science yet provided similarly attractive means to the end? The microscopical soiree comes nearest to this, but it is only an annual exhibition, and often lacks the most desirable feature for this purpose, viz., explanation. Let the soiree become a monthly, semi-monthly, or weekly gathering, and let the visitors spend 30 minutes in each evening in looking at the objects, after which they take their seats and listen to explanations of the exhibits and of the apparatus. Then let them return again to the inspection of the instruments, and it will be found that the soiree has begun to perform some of the functions of the dancing-school. We believe that such a course of instruction would pay, and that a considerable fee could be charged for the service. If adults can be taught science as conveniently as they can be taught dancing we believe that more people in this country ·uld yield to the ambition to learn science than to learn dancing. 'ıe former they may advance not only socially, but financially ıtellectually, whereas no one learns to dance with the idea ıvestment will pay financially or intellectually. Many

young people are deterred from learning to dance by religious and other influences. There is no prejudice against science, and universal respect for it.

The reason, then, why the better gives place so much to the worse is simply that scientific men have not the tact or the philanthropy to make its study and practice as attractive as is the study and practice of dancing.

And why is this? Largely because of our indifference, somewhat because of the mistaken notion, formerly rife and not yet dead, that it were better to have a corner on scientific knowledge. In order that the masses should not learn science there used to be efforts to hem it in by unknown tongues and technical phrases. There are still those who adhere to the customs created by the exclusionist without intending to make scientific knowledge exclusive. Their acts accomplish what they would deny to be their intention. The distinguished professor whom we have quoted is sometimes not understood by his audiences because of his having run so far ahead of even the mass of scientists in the invention and use of technical terms. Such use he deems a necessity. Until he can find a way to make himself understood by the dancers they will dance instead of listening to him; and why should they not?

If theology is to be for the few, keep it in Latin; if science is to be for the few, write it in the dead languages; if dancing is to be for the few, invent as many technicalities and Latin names as science has and it will be patronized by few. The time was when the professors of science knew so little of nature and of the relations of organisms that it was perhaps pardonable to conceal that little beneath words not understood by the masses in order that they might be looked up to as savants, but that day has gone. Let knowledge throw off all masks and clogs and, plain and naked, challenge the favor of the masses; then will a scientific meeting "draw" as well or better than a dance or a dinner. The professor has sometimes sacrificed a dinner to the pursuit of science. So will those who sacrifice a dinner for a horse race when they have learned the relative value of each.

We are negligent of our duty if we fail to put scientific knowledge within the easy reach of the masses. The microscope is the best instrument yet invented towards the accomplishment of this end, but it is sufficiently complicated to require skill in its use and study for its comprehension. These will be acquired by the masses if we make the way easy instead of being indifferent to their needs.

The Cole Studies.—Referring to Query No. 7, I would add that Mr. Arthur C. Cole has lately removed from Notting Hill, W., to 74 Webb's Road, Wandsworth Common, London, S.W., England.—R. H. W.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

17. *Paste for Photographic Prints. What paste is used that will not spoil or fade prints?—A. B.*

Use equal weights of pure starch and selected gum arabic, boiled with water to make a paste about the consistence of thin molasses. This should be well worked into the back of the moistened print before applying to the card mount.

18. *Crookshank's Magenta Bacillus. Where can I find a description of this bacillus?—T. R.*

Consult A Manual of Bacteriology, by Prof. E. Crookshank. An English publication.

19. *Kidney Epitheleum. What was Heidenhain's experiment to demonstrate the secreting function of the kidney epitheleum?—H. A. B.*

Half a drachm of a saturated solution of indigo-carmine was slowly injected into the carotid artery of a small animal. About half an hour afterwards the animal was killed and the kidney removed. It was thus shown that the epitheleum of the tubules separated the soluble matters and the glomeruli excreted water only.

20. *Imbedding in Celloidin. Whose method is best?*

Minot's methed is one of the best. Consult *Am. Mo. Mic. Journal*, Vol. VII, page 229, for this method in full. Also Vol. IX, page 69, for a good paper.

21. *Imbedding in Celloidin and Pyroxylin. Where can a description be found, and is it advantageous?—C. H.*

Celloidin and pyroxylin are practically the same. Celloidin being rather finer in grain is undoubtedly better for microscopical use.

22. *Imbedding or Embedding. Which is the correct term? —E. K.*

"Imbedding" is the proper word to use.

23. *Photography. Can some reader recommend a practical and useful text-book on general photography for an amateur? —E. P.*

"Will some of our experienced readers name such a book?"

24. *Eosin and Carmine. What are the correct methods for treating material stained in eosin and in carmine?—H. B.*

Material stained in eosin should be washed in water containing a little acetic acid, which sort of fixes the stain. Material stained in Beale's carmine may be washed in plain water; sections stained in Woodward's or borax-carmine should be washed only in acid alcohol; water will discharge this latter stain.

25. *Thoma Microme. Where can I find a complete description, with the best methods of using it?—C. R.*

Methods in Microscopical Anatomy and Embryology, by C. O. Whitman, published by Cassino, Boston, contains full information. The last edition of Carpenter on the Microscope contains a fair description; consult the *A. M. Microscopical Journal* Vol. XII, page 35, for a valuable paper on Imbedding and Sectioning, by Dr. W. C. Borden.

26. *Rust on steel parts of Microtomes. What will prevent and remove such rust?*

Vaseline applied will prevent rust. Fine emery paper used with oil will remove it.

27. *Photomicrographic Dark Room. Will some one give a brief but complete description, with the necessary reagents and apparatus?—E. P.*

A simple dark closet, large enough to contain a table and a shelf or two, may be used. The necessary materials are a ruby lantern, three flat trays, or even plates, if large enough to contain the photo plates, a glass graduate, a small scales, and several bottles for solutions. The water supply may be taken from a pail with a rubber tube in the side, furnished with a spring clothes-pin or clip; the waste water may fall in a pail below; a negative rack and a 2-inch camel-hair brush are conveniences. The chemicals will depend upon the formula recommended by the maker of the dry plate used, but the following specimen list will do the work: Soda sulphite, eikonogen or hydroquinone, potassium carbonate, and potassium bromide, for developing; mercury bichloride for intensifying; red prussiate of potash for reducing; soda hyposulphite for fixing. A printing outfit for paper prints would include one or two printing frames. Sensitized paper, gold chloride, soda acetate, card mounts, and two flat trays for toning and fixing. Washing prints means prolonged soaking in any convenient vessel. Vols. VI and VII of the *A. M. Microscopical Journal* contain a series of excellent papers on photomicrography, by R. Hitchcock.

Vol. XII, page 69, contains a valuable paper by Dr. W. C. Borden, on the choice of plates for photomicrography.

28. *Animal and Vegetable Cell. What is the difference chemically, microscopically, and morphologically?—A. E. Larson.*

A cell is a vitalized mass of albumen called protoplasm. If its vitality is sustained by the assimilation of other organized material it is presumed to be animal; if sustained by inorganic matter only it is probably vegetable. As animal cells are known to require both organic and inorganic material, no characteristic difference or definition has yet been formulated.

29. *White Blood Corpuscles. How can I make permanent stained cover-glass preparations?—E. L.*

Place a drop of blood on the cover and quickly sweep it off with the straight edge of a glass slip, leaving only a thin, even layer; immediately place it in the fumes of an osmic acid solution; after an hour or two the blood corpuscles will be darkened somewhat, but no special details are made visible by this or any other method of staining, therefore simply spreading and drying are sufficient; a glass slip having an old, well-hardened ring of shellac is warmed enough to make the varnish sticky; the well-dried cover is placed on the soft ring and pressed down. In normal blood one white corpuscle to about three hundred red ones may be expected. In certain diseases, cancer, tuberculosis, and especially leucocythæmia, the white corpuscles are relatively more numerous. The *Microscope*, Vol. XI, page 89, contains an article on staining blood with eosin.

30. *Spermatozoa. How may permanent mounts be made to show the organisms, stained or unstained?—H. L.*

Staining spermatozoa with eosin or aniline dyes may be done, but it adds nothing to details and is useless. Place a drop of the spermatic fluid on a slip, press a cover down upon it, and let it dry. A ring of varnish will prevent the intrusion of immersion fluids. A mount prepared as above, but with no ring or other protection, is now, after 6 years, apparently unchanged and shows the spermatozoa perfectly.

WAYS AND MEANS

actical Points in Handling Objectives to Obtain efinition.—If you want to compensate for thinner et the systems of your objective further apart; or

the same purpose may be effected by lengthening the tube of your microscope. If, on the contrary, you want to correct for a thicker cover-glass, set the systems closer or make your tube shorter.

I. Thicker cover, longer tube, and opening systems tend to over-correction.

II. Closing systems, thinner cover, and shorter tube tend to under-correction.

For the recognition of under- or over-correction by the appearance of the object, the writer has found the method of E. Gundlach to be of great practical value; and he would urge careful practical study of these appearances as affording a guide to the kind of correction needed, whether "under" or "over."

To illustrate the practical use of the above, suppose, for example, a condition of under-correction of "general spherical aberration;" then either of the conditions named will afford counteraction or correction, *i. e.*, either thicker cover-glass, longer tube, or opening systems of objective, whichever may be most convenient or practicable. It is, of course, in many cases impossible to alter the distance of lens-systems, owing to the objective being in a fixed mount, not adjustable; in such cases one of the other correctives may be applied.—*E. Pennock in Queen's Pocket Catalogue.*

Using Oil-immersion Objectives.—In using these objectives cleanliness is important. Only a small quantity of the immersion fluid (specially prepared cedar oil) should be used, and it should be wiped off as soon as possible when done using.

To remove the oil, blotting-paper should be used, and then, breathing on the front lens, wipe it lightly with a piece of clean, soft linen.

In order to keep the immersion fluid unchanged it should not be exposed to the air for any length of time, as exposure to the air will thicken it, and so alter the refractive index.—*E. Pennock.*

Preparing Sponges.—W. R. Melly reported to the British Association (1891) the following solution for killing sponges extended:

96 per cent. methyl alcohol	10 parts
Salt water	90 "
Natrium chloride	$\frac{6}{10}$ "

He places the specimen in a glass jar (2 x 1 inch) filled with water. Then add the solution, putting in one drop per minute; if not retracted after 45 minutes, pour on quickly some hot sublimate; in this way some specimens are secured half-retracted. To preserve specimens for sections put them in 1 per cent. osmic acid (for 2 minutes), and then successively in 5, 10, 20, 30 per cent. alcohol up to 90 per cent.; harden in absolute alcohol and imbed in paraffine; stain with borax-carmine and hæmatoxylin.

Poisoning Protoplasm with Quinine.—Quinine has been found to destroy amœboid movement. Quinadine has $\frac{1}{6}$ the poisoning power of quinine.

To Prepare Lignite.—Macerate in carbonate of potash for several days; cut thin sections, heat them in a watch-glass until they turn yellow, drop them in cold water, mount in glycerine.

Transparent Cement.—Take 10 drachms gum dammar, 6 of gum mastic, 6 of dried Canada balsam, 2 fluid ounces of chloroform, and the same of turpentine; shake until dissolved, and filter.

NEW PUBLICATIONS

Essentials of Bacteriology. By Dr. M. V. Ball. 12mo, pp. 159. Philadelphia: W. B. Saunders. Price, $1.00.

This is really a valuable little work to any one in any walk of life. To the general reader it will give a comprehensive view of a subject of which every reading man has a smattering. Here he will find known and proved facts stated in a concise form which need no special scientific training to appreciate. The illustrations of the bacteria are commendable as a rule, those which are colored being specially noteworthy. The microscopist should welcome the little book, as every user of the microscope is sure to meet with bacteria, especially if he study pond life, or make even temporary preparations with water. The busy physician will also find its concise statements advantageous, unless he is an expert in bacteriology, as few practising physicians can be. In a word, the book is what it pretends to be—the essentials of bacteriology, and the essentials only.

The author says that the bacteria breathe, eat, and digest, as they certainly do not in the ordinary acceptation of the words. Would Dr. Ball say that a diatom breathes and eats and digests? or that an infusorian breathes and eats? The infusorian swallows food and digests it, but the creature does not eat it. The bacteria [illegible] the diatoms absorb oxygen and nutriment, but to teach that [illegible] and eat and digest is bad teaching.

THE MICROSCOPE
AN ILLUSTRATED MONTHLY MAGAZINE.

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Selecting a Microscope.

By EDWARD BAUSCH,

ROCHESTER, N. Y.

[From *Manipulation of the Microscope*, pp. 90—98.]

When a person has concluded to obtain a microscope, a suitable selection is a matter of considerable importance to him. The varieties are innumerable, prices without end, and all sorts of claims are made for them. The variety of special lines of investigation involves nearly as great a variety of requirements. The amount of money to be expended; what shall be the stand; what the objectives; shall the entire outfit be purchased at one time or little by little, are all questions of paramount importance which the writer does not expect to solve, but hopes to give sufficient information that a more intelligent selection may be made than might probably be done otherwise.

Stands.—Starting out with the assumption that there are two classes of instruments to select from, the long and short tube, the first decision to reach will be this point. In a general way it may be said that there are no optical advantages in either, but whichever is adopted must be retained.

The principal consideration is whether the instrument is to be used in an upright or inclined position. If the former, the short tube is usually selected, as it can be used comfortably on a table of ordinary height. This one objection which might be and often is raised against the long tube is easily overcome by the friends of the latter providing a suitable table for the same. As the instrument is used in the upright position only in a few special lines of study, it is really only of weight in this direction, as the

instrument may be inclined to the most comfortable point, and when so is more comfortable than the upright position.

The joint for inclination of arm is generally conceded to be an advantage. While it may be the case that many of the upright instruments are in use in Europe, there are very few used in this country, and the preponderance of instruments shown in catalogues of foreign makers would indicate the same tendency.

Almost all instruments for reliable work are provided with fine and coarse adjustment. They are both necessary, the only question being whether the latter shall be by the sliding tube or rack and pinion. The former, while perhaps having the advantage of admitting a more speedy change of objectives, has a decided disadvantage in the hands of the student in endangering objectives and preparations. Further than this, it is almost impossible for the maker to centre the nose-piece with the tube, so that a change of objectives usually loses an object out of the field, and requires that it be looked for anew with each change. In the rack and pinion the nose-piece has an unvarying relation to the tube, and is not liable to this difficulty, and offers a steady and agreeable adjustment. The advantages of the rack and pinion seem to be generally appreciated in this country, for there are few instruments sold and used without it.

Whether an instrument shall be of japanned iron or lacquered brass is probably largely determined by the amount of money to be expended. As far as the intrinsic suitability of the metals is concerned, there is no difference. Brass, however, offers the maker a better opportunity for displaying his mechanical skill, and while it is no doubt true that many highly finished instruments are of poor workmanship in their working parts, it is also a fact that a well-made instrument is always nicely finished.

The size of instrument is worthy of consideration. If an instrument is to remain stationary in a practitioner's office or laboratory, it may be large without being cumbersome. If, however, it is intended to be carried about, it should be of the smaller and more contracted style.

Another important consideration is the space between the stage and base or table. While it is advisable to have the stage low on account of convenience in manipulating a slide, there should still be sufficient space for the convenient attachment of substage accessories. As a rule, the American pattern of instruments provides more room between the stage and base on the lower side, and between the stage and tube on the upper, than do the Continental. As stated previously, a variety of stages are offered on [illegible]truments of similar construction. The plain flat stage, while [illegible]red to some, offers no advantages over the ordinary round [illegible]ess specially made for examining specimens on slides [illegible]n the standard 3 by 1 inch. Some claim advantages

for a smaller stage than the length of the slide, so that this, projecting, admits of the slide being grasped and swung around the optical axis. These advantages, however, are not generally appreciated, and even if so, are offset by the drawback that in moving the slide it is apt to be tilted.

Spring clips are usually of similar construction, although varying in detail and curves. Properly constructed clips should have such thickness of metal and be so bent as to allow specimens to be brought under them without resistance and keep them properly in place without too much pressure and consequent friction.

A glass stage and slide-carrier may be considered a good investment, as it admits of the convenient manipulation of the slide without the grating feeling which usually accompanies the direct movement of the slide on the stage. Where systematic examinations of a specimen are to be made, a mechanical stage will be found a great convenience, and in petrographical work it is almost a necessity.

A sub-stage may, in a general way, be said to be preferable when it is adjustable, particularly in the use of a condenser. It is absolutely necessary to adjust the condenser for different objectives, and this must be done so nicely that a sliding movement is hardly sufficient. In biological work the condenser is at the present day a necessity, and this is now constructed as a separate attachment with all the necessary adjustments, in which the rack and pinion is deemed of first importance.

[*To be continued.*]

Microscopy and the General Practitioner.

By WM. N. BEGGS, M. D.

SAINT LOUIS, MO.

Instructor of Histology, and Director of the Histological Laboratory, St. Louis Medical College.

[*From the Medical Fortnightly.*]

If questioned, almost every physician will acknowledge that he ought to have a microscope, and be able to use it. Furthermore, almost every physician will more or less reluctantly confess that he himself does not possess one. The reasons for this are not very hard to discover. They are comprised under the following heads: the lack of proper microscopical instruction at the colleges at which they have studied; the failure to properly appreciate the scope and advantages of microscopy as applied to general practice; the want of time to put into practice knowledge previously attained; and, finally, a mistaken idea that a suitable microscopical outfit must necessarily entail a great expense.

It does not lie within the scope of this paper to discuss the first of these excuses, further than to say that that is a gap in medical instruction which is being filled very rapidly. There are now a large number of medical colleges in the United States in which ample instruction is offered in normal and pathological histology, bacteriology, and urinology. There is also a continually increasing number of medical men who are more or less competently employing the microscope in their general practice.

As to the use to which the general practitioner should put his microscope, there is a great difference of opinion. The generally accepted view as to the future position of the microscope is, in my opinion, far too sanguine, and I also question its advisability. It is too much to expect that the average general practitioner will employ his microscope in original investigations. The microscope should be used by the physician for diagnostic purposes, for the examination of urine, sputum (for the bacillus tuberculosis), gonorrhœal pus, and for little else. The diagnosis of pathological tissues (tumors, etc.) should be left to the expert.

Every physician should be able to use the microscope intelligently in the examination of the urine. The technique of microscopical urinology is not difficult, and the apparatus required is neither extensive nor expensive. The time necessary for such examinations is not great, and no practitioner can feel that it is time wasted, or that he could employ it more profitably at something else. The general practitioner should also be able to make a satisfactory examination of sputum for the tubercle bacillus, and urethal discharges for the gonococcus, in a great majority of cases. The technique is somewhat more difficult and the time required somewhat greater than in the examination of urine. Nevertheless in all but a small minority of cases it should not be necessary to call in the services of an expert.

On the other hand, however, the examination of pathological tissues, for the sake of making a diagnosis, should be left to those who have devoted special study to them. By this it is not to be understood that the practitioner should not study the tissues, normal or pathological. Far from that! Every physician should be possessed of a clear and definite knowledge of the structure of the different organs and tissues in both normal and pathological conditions. He should not, however endeavor to be both practical pathologist and practical physician. He will find that he has undertaken too much. Technique as applied to pathology (and bacteriology) is too complicated, the time required is too much, and the experience necessary to give weight to his decision is too great, except in the most outspoken conditions. He find that his time and work can be much more advantanployed. He will find it far more profitable for him

to devote himself to the intelligent study of the so-called practical branches of medicine.

As I have indicated, it is a mistake to suppose that for medical purposes an expensive microscopical outfit is necessary. Neither microscope nor objectives need be expensive. The stand should be as simple as possible, but should also be well made. It should be steady, not trembling at the least jar. The stage should not be too high. Nearly all of the high-priced microscopes made in the United States and England are, in my opinion, open to this objection. If the stage is too high the hands easily tire, a difference of half an inch in the height of the stage having a very appreciable effect on the ease of manipulation. Clips may be of advantage, or they may be a decided nuisance. They should certainly be removable, and in all ordinary manipulations, removed. Their only value is in fixing a preparation immovably in a definite position. * * *

The combination of ocular and objectives generally recommended with microscopes is not the best for medical purposes. Ordinarily two oculars (2 and 1 inch or 1½ and ½ inch) and two objectives (1 and ¼ inch, or ¾ and 1-5 inch) are recommended. Of the combinations of oculars, the first mentioned is preferable. It is seldom desirable to increase the magnification by means of the eye-piece. Definition is not increased, although the apparent size of the object is, and there is a loss of light and distinctness which are not compensated for by the increased magnification.

Neither of the combinations of objectives mentioned is advisable. A combination of a ½ or ¾ inch with a ⅛ inch is far preferable. The first gives a sufficiently low power for ordinary purposes. It can generally be divided, and then gives sufficiently distinct pictures if very low power is necessary. For a high power for medical purposes, the ¼ or 1-5 inch does not give sufficient amplification, and the ⅛ is to be preferred. It must be remembered that to be able to find a preparation, that which is known to be there is not what is expected of the objective. The tubercle bacillus and the gonococcus must be shown with sufficient amplification and distinctness to be readily diagnosticated by one not an expert microscopist. For this purpose the 1-5 is not enough. The ⅛ fills the demand, and the additional expense is slight.

With such an equipment as I have described the necessary work which every physician should do with the microscope can be accomplished. It is also not absolutely necessary to expend $75.00 or more in the purchase of such an equipment. Half that sum will be sufficient. Were it not for the ban which the protective tariff places upon importation, not more than from $20.00 to $40.00 would be necessary. While the tax upon education has been removed as far as colleges are concerned, it is a fact to be regretted that full and free opportunities for scientific education and work are denied the individual.

Polarized Light.

[Report of a lecture by Prof. John Cox before the Montreal Microscopical Society, March 4, 1892.]

The lecturer introduced his subject by explaining that common light moves in two planes at right angles to each other, while polarized light moves in one plane only, and that common light might be turned into polarized light, either by transmission or reflection. It was then shown that a beam of common light could be separated into two beams of polarized light when passed through a crystal having a double refracting power, and as Iceland spar was the medium generally employed by microscopists, a crystal of that substance was used in demonstrating this fact. Conducting the experiment still further, it was shown how by the addition of another crystal the two beams could be subdivided, and thus four distinct images or disks could be made visible on the screen. By interposing a thin plate of selenite, and rotating the analyzing prism, all those wonderful changes of color were produced, which were so familiar to those accustomed to use the polariscope. The lecturer alluded to the wonderful power which electricity was known to exert over a beam of light, and illustrated this portion of his lecture by means of a powerful magnet, to which was attached the wires from a battery. The beam of light was made to pass through some four inches of glass, affixed to the magnet, and as the current was turned off and on, the effect produced was very apparent. The application of polarized light in the study of crystals was next taken up, and illustrated by placing in the lantern a slide of a certain solution. This was thrown upon the screen, where the crystals could be observed as they formed. Shooting out from all sides and being tinged with innumerable colors, they looked not unlike a grand display of the aurora borealis in miniature, only with the colors greatly exaggerated.

The construction of the Nicol prism and its use was then referred to, and the phenomena of Newton's rings explained. Other phenomena connected with light were beautifully demonstrated and explained by means of a mechanical contrivance, consisting of a series of stands, having in them movable frames which could be revolved in their sockets. Across these frames were fixed two parallel bars of glass about one-eighth of an inch apart. These represented the different media through which the beam of light was supposed to pass. The beam of light was represented by a silken thread, which was passed through the spaces formed by the glass bars. One end was attached to a small electrical machine, while the other was held tightly at the opposite end. When the current was turned on, the end of the thread attached

tor was roated in a circuit whose diameter would be

about four inches, and when one of the frames was turned so that the glass space was at a different angle to the others, the thread was seen to pass through the same variations which, under similar conditions, a beam of light would be forced to pass.

Demand for Cheap Apparatus.—We are constantly publishing descriptions of home-made articles because some microscopists invent them and others want to imitate them. It is not a little surprising when a doctor writes that, not having the money to spend for a microtome, he had made one with a few cheap materials. But such incidents are of common occurrence. We know men who buy things on installments for use in microscopy. Devotion to science in such circumstances is little short of heroism, and we shall foster it by publishing every little device we can hear of, except when the inventor patents it, or when he sends the description of it to some obscure periodical which hopes to get out of its obscurity by copyrighting the description. In that case our readers will know why we do not report the device. We appeal, however, to every one who devises some little thing of general utility, to insist that other people's patents and copyrights be kept off of it, and that its use be open to the entire microscopical world without money and without price.

——o——

Resolving Amphipleura.—A gentleman who does not wish to posture as a critic but who wants to understand the matter writes in reference to "Amateur's" article in the March number, p. 94.

Amateur claimed to have resolved *Amphipleura* into transverse striæ with a dry $\frac{1}{5}$ objective and 2-inch eye-piece. To this, inquirer says: "The unaided human eye can separate no more than 250 lines to the inch (Abbe). The striæ are over 90,000 to the inch. Dividing 90,000 by 250 gives 360 as the number of diameters which the microscope must magnify in order to show the striæ. A $\frac{1}{5}$ lens with 2-in. ocular magnifies only 250 times. Will you arrange your apparatus as you had it in resolving *A. pellucida*

and with your micrometer actually measure the magnification obtained and report the result? Mounting the frustule in a high refracting medium would not enable you to see any more lines than 250 to the inch."

We think "Amateur" to have probably been in error about the number of his eye-piece, but shall be pleased to hear from him. And as he was praising a particular objective, we think it shows the dangers of trying to discriminate in print in favor of some particular manufacturer. This periodical does not print much of that sort of thing. All reputable manufacturers should receive from us practically the same treatment.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

31. *I have some parts of plants in glycerine, water, and spirits. Please indicate the steps how I shall proceed to cut sections, bleach and stain them. What text-book is good for practical botanical sections?*

Soak the specimens in water to remove the glycerine, harden them in good alcohol, cut with the razor flooded with alcohol and water, bleach them (if they require it) in Labarraque's solution of chlorinated soda, or in a weak solution of chlorinated lime (two to twelve hours are required), wash in water changed several times, then soak in a pint of water containing ten drops of nitric acid, to neutralize the alkali, to alcohol, stain, wash again in water, in good alcohol to dehydrate, clove oil, finally in balsam. A good, full article on bleaching and staining can be found in the *Am. Mo. Mic. Journal*, vol. VII, page 43.

Strasburger's Vegetable Histology, translated by Hervey, published by Cassino, Boston, is a good text book on vegetable elements.

32. *Trichina. What is the best stain and mounting medium for flesh containing trichina?—H. M. Whelpley.*

Use an ordinary carmine stain and mount in balsam. The muscle takes the stain and the trichina remain unstained and well differentiated.

33. *I have some pathological material in glycerine. How shall I prepare it for cutting and staining?*

Pathological material preserved in glycerine will be too soft to be satisfactorily cut. Soak in water to remove glycerine, place

in good alcohol to make it take stain more readily. Stain in carmine or hæmatoxylin, snip off a small piece and separate the elements in glycerine, with needles, thus making teased preparations.

34. *What is the disease Botryo-mycosis, where is it found and where can notes or literature be found ?*

Botryo-mycosis is a fungoid disease found in horses. It produces masses of small nodules in the lungs, resembling bunches of grapes ; the name means, *grape-like fungus.*

35. *Is there anything known about the nervous system in fresh-water sponges, and is there any literature?*

See *Am. Mo. Mic. Journal*, vol. VI, pge. 156; also vol. VII, pge. 205.

36. *Can you give me clear directions for using the Abbe-Zeiss Camera Lucida?*

This camera lucida consists of a prepared cube of glass mounted in a setting arranged to slip over the eye-piece of the microscope, and an attached arm supporting a plane mirror ; the glass cube contains an internal silvered reflector with a small central visual aperture. The microscope tube should be vertical and the drawing paper at the right, in a plane parallel to that of the object. Place the cube over the eye-piece, centre it so its visual aperture will be in the optical axis, the reflecting surface upward and toward the right, at an angle of 45°. The attached mirror must be directly above the drawing paper, its surface at an angle of 45°, to reflect the image of the paper to the silvered surface in the glass cube. The eye in position sees the object through the clear central portion of the cube, also the image of the pencil and paper on the silvered surface surrounding this aperture, blending into one picture apparently on the drawing-paper. The illumination of the object, and also the paper, must be regulated to secure good definition. This camera was intended for use with a vertical microscope, but the tube may be inclined provided the drawing board is placed at right angles to its axis.

37. *Where can I find direction for using the Thoma-Jung microtome for paraffine section, and can it be used for celloidin?*

See answer to Query No. 25.

The Thoma-Jung, Schanze, B. & L., and all such microtomes are practically similar in their operation, differing only in the mechanical details for raising the object to the knife. Paraffine or celloidin imbedded material can be equally well cut, and no special method is necessary for either instrument.

38. *What will prevent rust on the steel parts of the B. & L. and Schanze microtomes? I find they will still rust after applying vaseline and kerosene.*

The microtome should be well cleaned and carefully dried in hot air. Vaseline or even machine oil will usually prevent rust. All rusty spots should be well polished out, because such spots often continue to rust even under a coat of varnish.

39. *What is a good way to prepare the mesentery to demonstrate its histology?*

Stretch and pin a portion of the fresh mesentery to a cork, harden it in alcohol, stain, cut or tear a portion, and mount in Farrant's solution or balsam.

40. *What is a good way to mount a prothallus of fern?*

Soak it and mount it in a mixture of glycerine 1 part, alcohol 1 part, and water 2 parts.

41. *I have some dry specimens of moss. How shall I treat them for mounting—dry or in balsam?*

Mount some of the conceptacles dry—just as they are. Other parts may be soaked in water until softened, arranged or straightened, then into strong alcohol, clove oil, and then balsam.

42. *What is the way to examine fungus on tobacco leaves, etc., and how may permanent mounts be made?*

These are best cut fresh and green, and examined in camphor water. For permanent mounts, harden in alcohol, cut, stain, and mount in camphor water or glycerine. Some specimens may be mounted dry also.

43. *What is the best medium for trichina. I have tried glycerine, Farrant's solution, and dry. They all disappear within a year.—H. M. Farr.*

Trichinous muscle should be well hardened in alcohol, then cut, stained with carmine, and mounted in Farrant's solution, or balsam; will be as permanent as any other pathological mount.

44. *I have difficulty with my botanical preparations. The pith seems clogged with some opaque substance, not air bubbles. What causes these dark spots? Also, what is the best fluid for preserving specimens of wood before cutting?—L.*

This query does not define the spots clearly, nor mention the sort of wood affected. The "spots" may be crystalline, resinous, or fungoid. Define the spots more precisely, or send a mounted specimen to the writer for diagnosis. All tender wood should be preserved in alcohol. Hard, mature wood may be simply dried, and should be boiled to soften them somewhat before cutting.

45. *Where can the Taylor freezing microtome be purchased, and at what price?—A. E. McKay.*

The price is $15, and it can be obtained from Dr. Thomas Taylor, 238 Mass. ave. N. E., Washington, D. C.

46. *How may pictures be transferred to wood by means of methylated spirits, or some such method?*

The following is recommended: Soak the print in a saturated solution of stick potash in alcohol. Apply the print with a roller to secure good contact; the softened ink will be transferred to the wood surface.

47. *What method can be used for preparing teeth of flies?*

Teeth of flies refer to the rasps found on the bulbous extremity of the proboscis of the fly. These rasps have the appearance of closed spirals, but careful examination shows them to be split open, forming sharp, rasping teeth, operated by muscular action. Any mount of proboscis of fly should show them, but a mount in Farrant's solution is best for details.

NEWS · FROM · THE · WORKERS ·

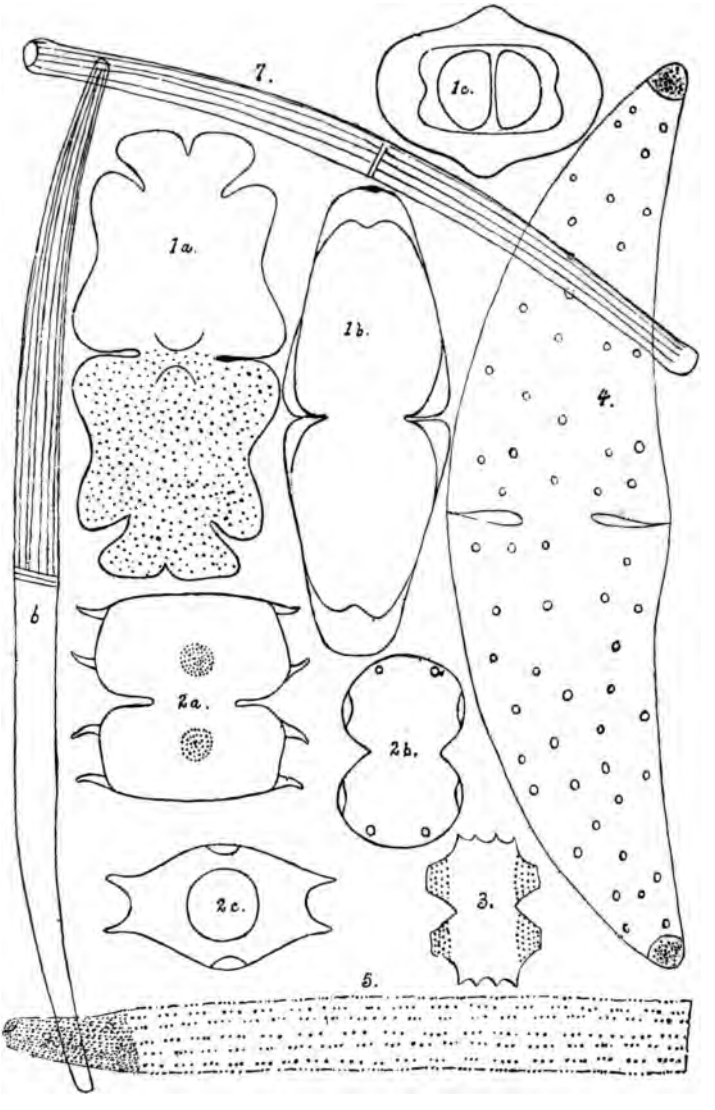
The Mobile Deposits.—Dr. D. B. Ward has identified about 50 species of diatoms in the Mobile earth, a list of which may be found in the JOURNAL for June.

The matron of the Mobile Protestant Orphan Asylum, Mobile, Ala., has about 50 vials of washed diatoms for distribution. The washing, which is very laborious, was done by the boys under direction of Dr. Taylor. We understand that any person desiring a vial can address the matron, sending such contribution to the funds of the asylum as he deems the material to be worth to him. We suggest that a dollar is not too much to enclose.

New Desmids.—Mr. W. N. Hastings has described the following new desmids in the AMERICAN MONTHLY MICROSCOPICAL JOURNAL for June.

EXPLANATION OF THE PLATE.

FIG. 1*a*. Euastrum magnificum variety crassioides, var. nov. Wolle, x 500.
FIG. 1*b*. Same, side view, x 500.
FIG. 1*c*. Same, end view, x 500.
FIG. 2*a*. Xanthidium truncatum, spec. nov. Hastings. Front view, x 500.
FIG. 2*b*. Same, side view, x 500.
FIG. 2*c*. Same, end view, x 500.
FIG. 3. Staurastrum megalonotum, Nord. var. Obtusum, var. nov. Wolle. Front view, x 500.
FIG. 4. Closterium robustum, spec. nov. Hastings, x 250.
FIG. 5. Closterium maculatum, spec. nov. Hastings, x 500.
FIG. 6. Closterium lineatum, variety costatum, var. nov. Wolle, x 250.
FIG. 7. Closterim angustatum Kg. variety clavatum var. nov. Hastings.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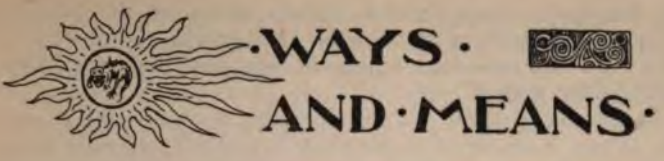

Camera Obscura.—Mr. Hans M. Wilder, of Philadelphia, calls attention to an item in *Journal* of the British Dental Association for February, bearing upon our two articles in March number, as follows:

A. Hopewell Smith uses the concave mirror for that purpose. Place the microscope horizontally, as usual, and remove the mirror from its attachment. The slide having been put upon the stage, condense the lamplight upon it by means of a bull's-eye, taking care to centre the light. The concave mirror is then attached to the front of the eye-piece in some fashion, so as to form an angle of about 45° with the plane of the eye-lens. The image will now be found projected onto the paper, and no distortion will occur if the outer ring of the light is *perfectly* circular. A dark cloth is thrown (photographer-fashion) over the head and body of the microscope, in order to exclude the light. This arrangement can be used easily with amplifications up to 500–600 diameters.

It will be remembered that Dr. Jos. Collins (p. 77) and Dr. H. G. Piffard (p. 2) both desire to exclude extraneous light. Mr. Wilder thinks it advantageous to use the black cloth thrown over the head after the manner of photographers. Pin or fold it together around the tube of the microscope.

Barbadoes Earth.—Referring to query No. 16, Rev. F. B. Carter writes:

"Barbadoes earth may be had of S. S. Day, Prudential Building, Newark, N. J. It is from the Springfield estate. I know

it to be good. I can furnish strewn slides of the Polycystina from five localities in Barbadoes, Springfield, Cambridge, Malvern Hill, and two other unknown localities, the first of which is exceedingly good."

ITEMS

In Austria the pharmacist is compelled by law to keep a microscope in his store.

Bausch & Lomb's New Buildings.—The largest of the new buildings will be 185 feet on the Vincent place, or south side, 80 feet on the east, 53 feet on the west, and 162 feet on the north, and will be five stories in height, including the basement. Between this and the present buildings, and coming a little in front of them, will be a handsome new engine-house 64 feet by 40 feet and 22 in height, with a very wide, massive stone entrance in front and a trussed glass roof. Immediately back of the engine-house is the boiler room, 40 feet by 60 feet, with room for four boilers, coal bunkers, etc., and back of this again will rise the large new chimney 130 feet in height. Over the rear part of the engine-room will be built a four-story connection between the old and new factories, 33 feet by 40 feet in size, and of a design to harmonize and unite the different styles of buildings. The engine-room will contain a fine new Harris-Corliss engine of 400-horse power, built especially for the Company, and through the room, and half way to the ceiling, will be a passage or walk where visitors in passing through to the new factory may see the working of the engine from above.

The new factory will contain a large elevator and two fire-proof stairways entirely separated from the floors by thick brick walls. The heating will be done by a large blower forcing fresh warm air into each story, and the most improved methods of ventilation will be employed, entirely independent of the windows. Every room will be equipped with automatic sprinklers, and the plumbing will be of the best appliances. The buildings will be lighted by electricity from the Company's plant of two 400-light Edison dynamos, the power of which is given by a separate 100-horse power engine.

The cost of the works which are now being constructed will be about $50,000.

Volcanic Dusts.—The following volcanic dusts from the Andes are being advertised as for sale in London at 37 cents per bottle, containing about 1 grain each:

1. *Cotopaxi*, eruption of June 26, 1877, which fell at Quito after an aerial voyage of 34 miles. In the brown glass chips vacuoles are abundant; many of them range from about .001 to .002 inch in diameter, but some are still smaller.

2. *Cotopaxi*, eruption of July 3, 1880, which was ejected to a height of 40,000 feet above the level of the sea, and fell on Chimborazo after an aerial voyage of 64 miles. The finest particles weigh less than one twenty-five thousandth part of a grain.

3. *The Terminal Slope of Cotopaxi*, 19,500 feet above the level of the sea. This is the matter which is ejected daily by the volcano.

4. *From 15,300 feet on Cotopaxi*, about 2000 particles to a grain. The granules commonly range from .01 to .015 inch in diameter. The most abundant are minute lapilli of scoriaceous aspect; in less numbers are glassy whitish and reddish granules—with these occur fragments of felspar, augite, and hypersthene.

5. *Lapilli from 15,000 feet on Cotopaxi.* Pumiceous lapilli, pulverized glass, and mineral fragments.

6. *Lapilli from Ambato (8600 feet).* Mainly colorless, vesicular pumice. Many of the fragments have entangled within them small microliths, and also plates of a pale greenish mica. The town of Ambato is built upon this deposit.

7. *From Machachi (9800 feet)*, existing as a continuous stratum ten inches thick, the product of some unrecorded eruption of great intensity. Consists largely of felspar and hornblende. The finest particles are felspar and pumice.

8. *Fine Pumice Dust from Machachi (9800 feet).* This forms beds many feet in thickness, and consists mainly of clear, colorless, vesicular pumice, which includes greenish mica, some in minute hexagonal plates.

NEW PUBLICATIONS

Education and Culture as related to the Health and Diseases of Women. By A. J. C. Skene, M. D. Detroit: Geo. S. Davis. 16mo, pp. 167.

This is a little book that can be read through at a single sitting,

but it is so valuable and so full of suggestive material that it will repay more than one perusal. Some of Dr. Skene's positions are not quite orthodox, perhaps, but these objectionable features add to the interest of the book, as they are sure to awaken the reader's thoughts, and the writer that can do this is to be commended. The author's assertions in reference to the teaching of physiology in the schools is one of the points that are open to criticism, although what he says is pertinent and suggestive. "Much may be said on both sides" of the question. Any physician can gain something from the book, and mothers with young daughters will find it a useful volume to have within easy reach for several readings.

Taking Cold. By Dr. F. H. Bosworth. Physician's Leisure Library. Detroit: Geo. S. Davis. 16mo, pp. 69. 25 cents.

This is the most sensible book of the kind that I have ever read. It is lucid, instructive, concise, and valuable. For the use of the non-medical reader it could scarcely be improved, except, perhaps, by the omission of the treatment of certain inflammations the result of cold. Several of these remedies can not be safely applied without the oversight of the physician. But for a clear elucidation of the cause and the *modus operandi* of taking cold the little book merits every commendation that can be given it.

Delsartean Physical Culture. By Carrica Le Favre. New York: Fowler & Wells Co. 16mo, pp. 108. 25 cents.

An explanation of the principles of the Delsartean philosophy, with an account of the physical and moral benefits to be derived from its practice. The author is much in earnest. The trouble with most of Delsarte's disciples is that they carry matters to extremes.

Practical Notes on Urinary Analysis. By Dr. W. B. Canfield. Detroit: Geo. S. Davis. 16mo, pp. 93. 25 cents.

Although many books have been written on this important subject, there still is room for this concise little treatise. But in its conciseness lies its danger. The author appears to be an expert in the prosecution of this particular kind of investigation, but he has not made the subject attractive and lucid to the ignorant novice. To the advanced urinalyst, who has by personal experience and observation become familiar with the reactions, with the microscopic appearances of the ordinary deposits, and with their microscopic characteristics, the book will prove a valuable one by its suggestiveness. With a more extended treatise within reach, Dr. Canfield's small book merits a place in every physician's office for the purpose already mentioned.

·THE·MICROSCOPE·

AN ILLUSTRATED MONTHLY MAGAZINE.

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Selecting a Microscope.

BY EDWARD BAUSCH,

ROCHESTER, N. Y.

[*Continued from page 131.*]

Objectives and Eye-Pieces.—It is hoped that the information given of the various qualities in an objective will aid to make a suitable selection of the optical parts. As stands have been classified in long and short standard tubes, the next thing to look for after the stand has been selected is the adaptability of objectives and eye-pieces to it.

As will have been seen under the proper head, a variety of powers is obtained by a suitable combination of eye-pieces and objectives; and while power alone can be obtained by increasing the power of the eye-piece, it is not advantageous to do so. For ordinary work no higher eye-piece than a $\frac{3}{4}$ should be used. In catalogues, many outfits are made up of one eye-piece and two objectives, but this is only for the purpose of reducing price to a minimum. It is always advisable, when means will permit, to select two eye-pieces, preferably the 2-inch and 1-inch, and insist that they be par-focal, as this will be found extremely convenient and will not disturb the optical standard length. If for any work $\frac{1}{2}$-inch or higher powers are desired, the solid eye-piece may be recommended. The periscopic are advantageous for micrometric tests and other work where a large or flat field is desirable.

For students' and practitioners' use, the outfits as made up in catalogues are usually sufficient, except as above recommended, where but one eye-piece is given; it is well to select two where means will permit.

Referring particularly to the catalogue of the Bausch and Lomb Optical Co., we will state the purpose for which they were intended.

Biological.—Laboratory, student, and professional use.

Large Biological.—Advanced laboratory, student, and professional use.

Harvard.—Laboratory, student, and professional use.

Model.—Laboratory, student, professional, and amateur use.

Physican.—Professional.

Investigator.—Student, professional, and amateur use.

Universal.—Student, professional, and amateur use.

Concentric.—Professional and amateur use.

Professional.—Advanced laboratory, professional and amateur use.

For ordinary professional use, including urinary examinations, the $\frac{3}{4}$-inch 27 degrees and $\frac{1}{6}$-inch 110 degrees objectives will be found sufficient. For bacteriological examinations a higher power, such as a 1–12-inch homogeneous immersion objective will be necessary. If means will permit, an investment in the $\frac{3}{4}$-inch 40 degrees and 1–5-inch 130 degrees, or $\frac{3}{4}$-inch 40 degrees and 1–6-inch 140 degrees will be well applied. This latter is in very general use and may be very highly recommended. In botanical work a lower power than those mentioned, such as a 2-inch 13 degrees or preferably, 2-inch 15 degrees will be necessary. For amateur use the ordinary outfit of $\frac{3}{4}$ inch 27 degrees and 1–5-inch 110 degrees, with the addition of a 2-inch, preferably of the better grades, will do. If the examination of diatoms will be followed, the 1–6-inch, 140 degrees and 1–12-inch homogeneous immersion will probably be required. For the student, the $\frac{2}{3}$-inch 28 degrees and 1–6-inch 116 degrees, or $\frac{3}{4}$-inch 27 degrees and 1–6-inch 110 degrees, objectives will ordinarily be ample.

Although from an optical standpoint it is true that objectives give more detail as they increase in their angular apertures, it will have been seen that the highest class of objectives is not always recommended. A great portion of every-day work does not require this maximum of optical results, and can be accomplished completely and with comfort with objectives of comparatively low aperture. Some years ago microscopists were divided into two classes, the new school of wide aperture and the old school of narrow aperture. The state of affairs existing then has happily changed, concessions having been gradually made, so that now the advantages of both class of objectives are appreciated and there are few microscopists of standing who would recommend only one or the other kind.

In these days of competition, prices alone are too often made the object of inducement, without any reference to quality. Be distrustful of all such objectives, and if contemplating their pur-

chase, always reserve the right to have them examined by an expert. Have a distrust especially of all "nameless" objectives. It is safe to assume that if the maker cannot attach his name he is doubtful of their superiority. Any maker of responsibility will say without hesitation that he can produce objectives at less than one-half their present cost, if he had the assurance that they would be accepted as first put together, as the cost of merely making and mounting lenses is considerably less than the cost of making proper corrections. In this case, however, they would be of varying and inferior quality.

It is sometimes found that dealers offer the same objectives of different quality at different prices. Too great care cannot be observed in such cases, as the very fact of the admission of a difference in quality indicates that they are made by an unreliable maker. This mode of offering objectives was in vogue many years ago, when the principles of optics and facilities for making were limited, and when a higher price was asked for those which might be termed a happy combination. There is no excuse, however, at the present day, for anything of this kind, because every conscientious optician has his standard for every objective, which is his guide.

In purchasing a microscope, a beginner may be easily misled by the enticing appearance of an object, which may be due not so much to the instrument as to the object itself, and if the optical parts are inferior it will require but a short experience to become convinced of it—usually as soon as a comparison can be made with reliable work. The investment in one of these objectives is not only a source of disappointment, but usually proves to be a pecuniary loss, as it is usually followed by a fresh outlay in responsible work. It is of ordinary occurrence that such objectives as have just been spoken of are sent to the writer's firm with the request to examine them and rectify the faults; but an examination almost invariably proves that the cost of doing this is considerably greater than purchasing a new objective of the same power, and it would not even then be equal to the latter.

How to Collect Desmids.

By WM. N. HASTINGS,

ROCHESTER, N. H.

Desmids are microscopic unicellular fresh-water plants, and belong to the order Algæ. Under favorable circumstances the largest of them may be seen by the naked eye as minute green specks in the water. The smallest of them require a good compound microscope for identification, being of no greater diameter

than a human blood corpuscle. They differ from diatoms most strikingly in the cell-wall being soft, and it is said to be composed almost wholly of cellulose (the material of cotton), while the cell-wall of diatoms is infiltrated with silica (the material of glass), which renders them brittle. From other algæ they are chiefly distinguished by each cell being composed of two symmetrical half cells joined at their bases, which are sometimes so much constricted as to appear to be two cells, but as the protoplasm (bioplasm or life substance) circulates from one to the other they really form but one individual cell. Desmids differ from one another in shape, size, markings, and the presence or absence of processes, angles, spines, etc. Over thirteen hundred of them have already been described, and while it seems really wonderful that so many and beautiful forms can be fashioned from a single cell, the student will readily understand that the possibilities are almost infinite. Desmids have a small power of motion, which is usually so slight as to escape observation, but it is sufficient to extricate them from sediment when they are not too deeply buried.

While desmids may be found at any season when we can get at the bottom of shallow ponds, the best will be found when all plant life is in vigorous growth. Sink-holes which have no visible outlet, and from which the water never entirely disappears, are generally excellent gathering places. Shallow ponds, still, shallow coves of lakes, mill ponds, and quiet pools in streams are promising resorts. They may often be plentifully found clinging to the long water-weeds, from which they may be detached by dipping the weeds into a bucket of water and rinsing them up and down. The size of the pool often bears no relation to its importance. A small cavity in low ground, from which the moisture almost but never quite disappears in times of drouth, and which is scarcely two feet across, has produced two new forms. It was formerly the bed of a small granite boulder, and is lined with a growth of sphagnum moss, from which it seems always possible to squeeze a few drops of water, and when driest yields semi-cells of the plants free from chlorophyll and in best condition for examination of their markings. A small depression in a similar place, apparently made by the pressure of an ox's foot, was a valued treasury for several months, though it gave no forms new to science.

The outfit for gathering samples of water need be neither large nor expensive. A dozen one-ounce wide-mouthed round-shouldered prescription vials, costing, with their necessary corks, twenty-five cents, a pond-stick cut from the roadside, a hand magnifying glasss, costing another quarter, and a small memorandum book are the only requisites for preliminary search. The pond-stick is usually a grey birch about three-quarters of an inch in diameter at the large end, which is flattened on opposite sides for

about six or seven inches, split vertically to the flat sides, and a notch cut from the inside of each jaw forming the sides of the split, so that they may securely grasp the neck of the one-ounce vial. Having secured a sufficient number of samples from localities whose names and descriptions are recorded in the book, they are taken home and carefully examined under the microscope. Always enter the names of localities in a permanent record, and label each vial with the name of locality and date of gathering. It will save many regrets. If any region gives sufficient promise it should be visited again and a larger quantity of material secured. This time the outfit consists of a lard pail containing three or four fruit cans fitting one into another, and a self-sealing fruit jar. The top sediment is carefully gathered and put into the cans to settle, which, when enough has been obtained, is put into the jar, sealed up, and carried home. A portion is taken out for examination as it is. The rest is strained through lace—mosquito-netting will do. This takes out the filamentous forms that interfere with the next operation. Desmids usually occur as free or single cells; but some beautiful forms are usually joined into filaments, and these will be found in the unstrained sediment. After straining the material is put into one-ounce vials, a little in each. The vials are filled with fresh water and set aside in good light until the next day, or sometimes until the second day, when the desmids will be found on the surface of the sediment, or, if entirely successful, they will be found separated from it by a layer, the mucus before spoken of. They may be removed without disturbing the sediment by carefully using a rubber-capped pipette. This material will be made up of nearly clean desmids, and is much more satisfactory for examination than the usual mixture of desmids and dirt. If the operation is not entirely successful and some sediment is found, it may be sometimes repeated, but it is best to be careful (and hence successful) the first time. To preserve this cleaned material, which would otherwise soon become foul, it may be put into a one-ounce vial of water with five drops each of glycerine and strongest carbolic acid. The acid will preserve it and the glycerine will prevent loss by drying out under the microscope, which is very provoking when one is studying a rare form and forgets to renew the water. This preservative answers as a mounting fluid unless it is desired to preserve the color, in which case carbolic acid must not be used. Pure glycerine has preserved a fine green color for several years, but the endochrome has always been shrunk from the cytioderm. The slides must be kept from the light as much as possible to prevent bleaching. Having generally wished to get rid of the cell contents not much can be said as to their preservation. Time and natural causes are principally relied upon for their removal, as no chemicals have been tried that do not act injuriously upon

the markings of the cell-wall. These markings can be well made out only upon empty cells; best of all are those found empty in the gatherings, and some empty semi-cells may usually be had by careful search among the sediment in which the living cells are found. When they are not found patient waiting and occasional examination are the remedy.

Use of the Microscope in Pharmacy.

By H. M. WHELPLEY, M. D.,

ST. LOUIS, MO.

[From a paper read at the A. S. M., 1891.]

Use of the Compound Microscope.—*a*. The study of vegetable histology is of much importance to the educated pharmacist, as animal histology is to the qualified physician. While work in vegetable histology does not require the use of an instrument with as high powers or present as many difficulties as are found in animal histology, still the microscope is just as essential in this line of investigation as in the one followed by physicians. The different vegetable tissues are as readily recognized as bone and muscle. A pharmacist can as easily distinguish a section of wood from a section of bark as an animal histologist can tell a section of bone from a section of epidermis. The arrangement of the various tissues in corresponding organs of different plants are quite characteristic; thus it is that one who is versed in the work can distinguish a transverse section of dandelion root from a similar section of chickory root.

This is simply one example of how the microscope will enable the educated pharmacist to identify a genuine drug or detect an adulteration.

b. The United States Pharmacopœia, the dispensatories, which are commentaries upon the Pharmacopœia, and all works on materia medica for pharmacists, recognize the importance of studying the microscopical appearance of transverse sections of vegetable drugs. While the Pharmacopœia is not an illustrated work, it gives quite explicit descriptions of the appearance of drugs as seen under the microscope. In the commentaries on the Pharmacopœia and the works on materia medica, we find illustrations of the drugs as seen under the microscope. The study enables the pharmacist to identify drugs, tell the quality, detect substitutions, adulterations, sophistications, and admixtures.

c. The study of the microscopical appearance of powdered drugs has not been carried to that degree of perfection which has been reached in vegetable histology; however, the field is an inviting one, and it is here that the pharmaceutical microscopists of the future will be able to do the most valuable work. Some

idea of what can be done is shown by the work that the Department of Agriculture of the Government is doing in the examination of spices. See "Bulletin No. 13" of this Department.

Many of the histological elements of plants are such that they are readily recognized, even in the mutilated condition found in powders. It is often possible to identify cells from pith and other characteristic tissues, like the bast in cinchona, the stone of cinnamon, and the pitted ducts of red cedar. I remember an instance where a sample of powdered red pepper was simply fine red cedar sawdust flavored with the oleoresin of pepper. A glance at the mixture under the microscope revealed its true nature. In coarse powders it is sometimes possible to recognize the stomata of leaves.

d. Pharmacognacy, or the recognition of drugs, is studied by aid of a system based upon the physical characteristic of the substances. As an example, we study the structure and characteristics of a leaf, which is one of the subdivisions of that great class of drugs derived from the vegetable kingdom. Leaves are again subdivided into two kinds, the herbaceous and coriaceous. These two classes are readily distinguished from each other by an examination without the aid of the microscope. However, the case differs when we come to the study of several other subdivisions of vegetable drugs. For instance, we take the roots, which is a subdivision corresponding to the leaves. The roots are divided into two similar subdivisions, known as the mono-cotyledonous and the di-cotyledonous. It is by means of examining a transverse section of these roots under the microscope that the pharmacist determines to which subdivision they belong. The dicotyledonous are again subdivided into woody, with thick bark; woody, with thin bark and fleshy roots. As is readily understood, this classification is based solely upon characteristics revealed by the microscope. To continue with the subdivision one step further, we have the woody roots with thick bark, divided into those with oil, resin, or latex ducts and those without oil, resin, or latex ducts.

The advantage of such a system of classification is an interesting subject, but does not directly concern us as microscopists. Its consideration usually occupies an entire lecture in the College of Pharmacy.

e. The use of the microscope in microchemistry is not advanced as far in pharmacy as the use of the instrument in vegetable histology. The principal reason for this is owing to the difficulty of studying crystallography. A few of the more common salts like the cinchona alkaloids have been studied and their microchemical appearance are figured in the dispensatories. I have no doubt that microchemistry applied to pharmacy will be greatly advanced by the active pharmacist of the future.

f. The introduction of the compound microscope in the examination of urine is by no means recent. The value of the instrument in this work is so thoroughly recognized that it does not admit of debate. The examination of urine as a part of a pharmacist's work is fast gaining a similar position.

g. In conclusion, there are many incidental uses for the compound microscope in a drug-store, such as the examination of the smaller insects which infest drugs, the study of moulds which are found in pharmaceutical preparations, and other uses which suggest themselves to pharmacists with an investigating turn of mind.

Double and Metallic Stains.

COMPILED BY PROFESSOR A. B. AUBERT,
ORONO, ME.

Bismarck Brown and Methyl Green.—Bismarck brown, a concentrated warm aqueous solution, or a weak alcoholic solution. Methyl green, 0.5; water, 100. Sections to be kept in about 15 minutes; wash with water; stain dark green, wash, soaking in alcohol until grass green; clear in oil of bergamot, xylol; mount in balsam.

Borax, Carmine, and Indigo Carmine.—1. Carmine, 2 grms.; borax, 8 grms.; water, 130 grms. 2. Indigo carmine, 8 grms.; borax, 8 grms.; water, 130 grms. Mix 1 vol. of 1 and 2. Sections are taken from alcohol and stained in from 15 to 20 minutes; transfer from 15 to 20 minutes to concentrated solution of oxalic acid; wash; dehydrate; mount in balsam.

Eosin and Methyl Green.—I. Eosin, 1 part; methyl green, 60 parts; alcohol, 30%; warm. II. *A*. Eosin, 1 part; water, 50; alcohol, 50; *B*. Methyl green, 1; water, 100. Sections stain in 1 in 5 or 10 minutes; quickly wash in successive alcohols, mount in balsam or glycerine. II. Is for blood corpuscles; dry the blood (thin layer) on the slide; treat with *A* 3 or 4 minutes, wash stain off with water; treat with *B* 2 or 3 minutes, wash, dry, mount in balsam (red corpuscles red, nuclei and leucocytes bluish green).

Fuchsin and Methylin Blue.—*A*. Fuchsin solution in alcohol, 8 to 10 drops; water, a watch-glass full. *B*. Concentrated aqueous solution of methylin blue. Tissues to be hardened in chromic acid, etc.; stained in *A* for several to 24 hours; washed with alcohol, stained in *B* for 4 to 5 minutes (nuclei red, tissues blue).

Hæmatoxylin and Eosin.—Solution of eosin in glycerine in
:h some salt has been dissolved; concentrated solution of
in glycerine, and glycerine hæmatoxylin. Stained speci-
washed in alcohol containing a little eosin; clear in oil of
mount in balsam.

Picro Carmine.—I. Carmine, 1 grm.; liquor ammoniæ, 4 c.c.; mix and add 5 grms. picric acid. II. Carmine, 15 grms.; picric acid, concentrated solution. Agitate the mixture (I) from time to time for 2 days; let it settle; decant and evaporate decanted liquid at ordinary temperature; redissolve the dry residue in water, making 1% or 2% solution; filter when necessary. II. Triturate the carmine in a mortar until very fine; add enough ammonia to dissolve the carmine; to this add slowly-concentrated solution of picric acid until the mixture has a blood-red color; keep in a shallow dish until all odor of ammonia has disappeared; filter; keep in a well-stoppered bottle; add a few drops of carbolic acid; filter before using.

Picro Carmine and Eosin.—Solution of picric carmine, 1%, 1 part; watery solution of eosin, 2%, 1 part. For small organisms ½ to 4 days; wash in 70%, then in 90% alcohol.

METALLIC STAINS.

Ammoniacal Nitrate of Silver.—Silver nitrate 0.75 to 0.5 per cent. with ammonia. Add to nitrate of silver solution enough ammonia to re-dissolve the precipitate which forms at first; dilute to 0.75 per cent. or 0.5 per cent.

Gold Chloride.—*A.* Gold chloride, 1 grm.; water, 2,000 c.c.; hydrochloric acid, 30 drops. *B.* Alcohol, 1 part; formic acid, 1 part. Sections treated with *A*, then transferred to *B*, where reduction of the gold takes place.

Potassium Gold Chloride.—*A.* Potas. gold chloride, 1 part; water, 10,000 parts; hydrochloric acid, a trace. *B.* Water, 2 to 3,000 parts; hydrochloric acid, 1 part. *C.* Alcohol, 60 per cent., 1,000 parts; hydrochloric acid, 1 part. Sections hardened in ammonium bichromate are put in *A* for from 10 to 12 hours, until they are of a light violet color, washed in *B*, and transferred to *C*.

Osmic Acid and Silver Nitrate.—*A.* Potas. bichromate, 2 per cent., 10 parts; osmic acid, 1 per cent., 1 part. *B.* Silver nitrate, 1 part; water, 200 parts. Objects soaked in *A* for several hours, transferred to *B* for at least 8 hours.

Silver Nitrate.—*A.* Silver nitrate, 0.25 to 0.5 parts; water, 100 parts. *B.* Salt, 0.75 parts; water, 100 parts. Sections 20 to 40 seconds in *A*, then in *B*; move them about in both, then expose to the light.

Silver Nitrate and Silver Iodide.—*A.* Silver nitrate, 1 part; water, 100 parts. *B.* Silver iodide, 1 part; water, 100 parts; potassium iodide, a trace. *C.* Silver nitrate, 0.1 part; water, 100 parts. Put the sections in *A* (in the dark); after 2 or 3 minutes add a few drops of *B*; wash the sections in water and expose for 2 days in *C* to the action of the light (cornea).

An All-around Microscope.

By Prof. S. A. FORBES,
DIRECTOR ILLINOIS STATE LABORATORY OF NATURAL HISTORY, CHAMPAIGN, ILL.

My personal studies are of a kind to require a microscope which may be used (1) for the study of bacteria slides, (2) for the study of mounted slides of serial sections, (3) to search through and examine carefully collections of minute alcoholics in glass dishes, (4) to dissect animals under powers varying from twenty to two hundred diameters, and (5) to study pinned insects in all positions.

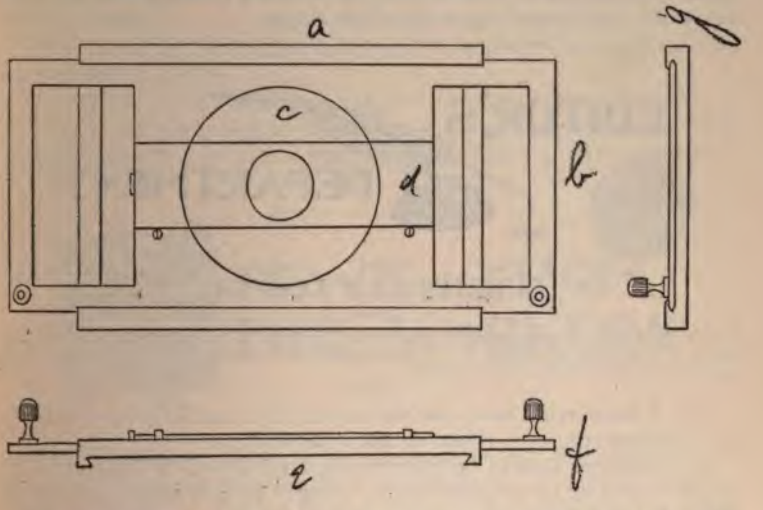
For the first purpose one must have a stand fitted to carry objectives of the highest power and the best illuminating apparatus; for the second, something in the nature of a mechanical stage is very desirable, but this should have a wider sweep than the ordinary geared stage; for the third, one must be able to explore rapidly and with low power a large surface, moving back and forth along parallel lines as with a mechanical stage, but with much freer motion in all directions. The stage must also be without surface projections or attachments, which would be in the way of a glass dish of considerable size. The instrument must, further, stand erect, and yet must not be too high to work at sitting. It is a great advantage if both eyes may be used. Fourth, for dissection hand-rests must be provided, and the microscope must usually stand erect, and should be a binocular. Fifth, for entomological work a binocular is needed, with stage socket for insect forceps, and with a large central opening in the stage to allow the ready turning of the object without interference of the pin or danger of injury to the specimen. As this large opening will admit light beside the condenser in bacteria work, it must be fitted with an adapter with a smaller opening. In this work, also, the rectilinear movement of a mechanical stage is a great convenience for bringing insects readily into the field.

As I accomplish all these purposes perfectly by a single microscope, it seems to me that this instrument must be adapted substantially to everything which the biologist is likely to want to do with a microscope, and that a description of it may interest many situated similarly to myself.

My starting point is a Zeiss stand, No. 1, with oculars 1 to 5 (No. 3 being divided for the insertion of a micrometer), and objectives ranging from A^3 to an apochromatic 1-12, with the corresponding eye-pieces. For ordinary binocular work I have an Abbe stereoscopic eye-piece, which has the advantage over other binocular arrangements, that it does not so increase the height of the erect instrument as to make it inconvenient to use it with low ers while sitting.

special feature of the instrument is the stage, which is the ' form of a mechanical movement in two rectilinear di-

rections, adapted to the square stage of my instrument as illustrated by the engraving accompanying*. The stage-plate of the microscope is altered by a triangular groove along the whole length of the lateral margin, and by an enlargement of the central aperture. Into this a heavy diaphragm may be slipped with an opening of the usual size for the Abbe condenser.



The apparatus for mechanical movement is essentially the ordinary mechanical stage, but working directly by hand instead of by rack and pinion, the especial advantage being the free long movement thus permitted. It is in two parts ; a rectangular frame (see *a*, *e*, and *g*), the lateral bar of which is beveled to fit into the triangular groove in the side of the stage plate, in which it slides forward and backward; and a thin plate (*b* and *f*) longer than the preceding and a little narrower, its beveled edges sliding laterally in a V-shaped groove on the inner edges of the anterior and posterior bar of the frame just mentioned. The projecting ends of this plate serve as hand-rests in dissecting. Three small screws are set in it as stops for the slide, and the knobs by which it is moved are bored in the centre as sockets for the stage forceps. Its central opening is of the same size as the larger opening in the stage-plate, and in this rests loosely a circular piece of glass (*c*), on which a dish may be set in examining small alcoholics. This apparatus, when well fitted and smoothly ground, works with a nicety and precision

*In this cut the larger figure shows the stage from above, the front edge uppermost; the figure to the right gives an end view; and the lower one a view from behind.

scarcely, if at all, inferior to that of the geared movement. An ordinary slide in position is shown at *d*. This stage was made October, 1890, to my order and from my drawings, by the McIntosh Optical Company of Chicago, from whom I learn that it is now furnished with many of their own instruments, being adapted to the round stage-plate of their microscopes by placing under it a thin false stage-plate which bears beneath a socket that slips into the central opening of the stage.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

48. *I have some zinc cement which does not harden properly nor become white. What is the remedy?*

Zinc cement should be thoroughly stirred and tempered with good benzol or turpentine before using. If this does not help it, throw it away and procure a good article.

49. *Why is it that balsam mounts kept in clips for a week or more will not harden until the superfluous medium is cleaned away, then the air runs in and spoils the mount?*

Balsam must necessarily shrink when the solvent evaporates. This must be provided for and time given for the medium to harden. If air runs under, gently heat the mount until the softened medium flows to the edge, and supply a drop or two of fresh medium to allow for shrinkage.

50. *What is the method for mounting dendritic spots on paper?*

Mounted dry, in a shallow cell, will present the most natural appearance.

51. *How may cocoliths and other organisms from chalk be mounted?*

These are best mounted in balsam; some of them are very ty as dry (opaque) mounts.

it common for vorticellæ to be attached to cyclops?

branched vorticellæ are common on cyclops, also on ic larvæ of insects.

53. *Who are the workers on F. W. sponges, and what literature is available?—Bullard.*

Fresh-water Sponges, by Edward Potts, published by the Academy of Natural Sciences, Philadelphia, Pa., 1887, octavo, paper. Rev. C. H. Rowley, Townsend, Mass., prepares sections. THE MICROSCOPE, vol. VII, has two papers by Henry Mills.

The MICROSCOPE, vol. X, contains a series of papers, very full, by Ed. Potts.

The *Am. Mo. Mic. Journal*, vol. IX, contains two papers also by the above author.

54. *What are "strewn mounts"?*

This term is applied to diatom mounts which contain all the forms of a certain specimen of earth evenly distributed on one cover.

NEWS · FROM · THE · WORKERS ·

The Potato.—What may be learned by a microscopical study of the potato is described at length by Professor Osborn in the JOURNAL. Not the least curious is the position of the buds, as shown in figure 1. Let any one take a well-formed potato and with a pencil connect the eyes as shown in the figure and then number the eyes in order. It will be found that the 12th is under the 17th, the 7th under the 12th, the 2d under the 7th, etc.; add 5 to the number of any eye and it gives you the number of the eye directly over it.

EXPLANATION OF PLATE.

(All figures were drawn with the Camera Lucida.)

FIG. 1. Surface view of tuber, showing the law of position of the buds, x $\frac{2}{3}$ natural size.

FIG. 2. Vertical section of the stem through a bud, showing the bud with its terminal portion at *b*, and its leaves at *a*, with the thin layer of bark and the pith in which, parallel with the bark, lies the fibro-vascular layer.

FIG. 3. Vertical section of stem magnified 133 diameters, showing (1) the bark cells at *c* in rows, the edges of which produce the parallel lines seen in the surface view (Fig. 4); (2) the living subdermal cells specialized as starch producers. The uppermost are full of protoplasm (at *d* in the figure); below them are cells containing large vacuoles and in which the starch grains are forming (cf. figs. 7, 8, 9). There are only a few rows of these before the cells filled with starch are reached at *st* in the same figure.

FIG. 4. Surface view of the bark cells magnified 133 diameters.

FIG. 5. Flat view of cells immediately below the bark from the level marked *d* in fig. 3. After treatment with weak acid these cells, before irrigation of the acid, appeared to be absolutely empty.

FIGS. 6, 7, 8. Greatly enlarged views of nucleus and surrounding protoplasm from cells at level of *e* in fig. 3, showing the starch granules surrounded by the protoplasm in different stages of formation.

FIG. 9. Section magnified 240 diameters, showing the fibro-vascular bundle with its spiral cell and the cylindrical cells on either side.

Fig. 2.

Fig. 6.

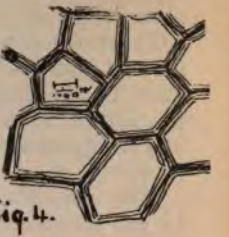


Fig. 4.

Fig. 5.

Fig 8

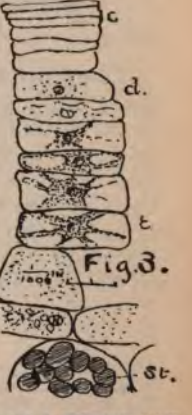


Fig. 3.

Fig. 1.

Fig. 7.

Fig. 9.

WAYS AND MEANS

Imbedding Delicate Objects in Celloidin.—The object, properly fixed and hardened, is placed for twenty-four hours in a mixture of equal parts of alcohol and ether. It is then transferred to a thin syrupy solution of celloidin, made by dissolving celloidin in a mixture of equal parts of alcohol and ether. After remaining in this solution for about twenty-four hours the object is covered with a thicker solution of celloidin, and is allowed to remain in the same for about twenty-four hours, when it is ready to imbed on cork.

When ready to imbed the object, a small quantity of the celloidin solution is spread on clean glass (a slide will answer the purpose), and allowed to dry. Then another coat is applied, and allowed to dry. This affords a firm celloidin bed upon which the object is placed and arranged, care being taken to place it in the desired position as quickly as possible before the celloidin begins to harden. The whole is now covered with successive layers of the celloidin solution until a firm support is built up for the object. When sufficiently dry, the celloidin is removed from the glass by means of a sharp knife, and if necessary a pair of scissors is used to trim the bed to the proper size and form. It is now ready to imbed on cork.

The top of a cork is coated with celloidin solution and allowed to dry. This is done to prevent air from rising from the cork and forming bubbles in the celloidin. The object, in its matrix of hardened celloidin, is placed in the desired position on the cork, and fastened to it with celloidin. After drying in the air until a layer is formed on the outer surface firm enough to retain the shape, the cork is dropped into 50 per cent. alcohol. Usually the object is ready to cut after remaining one hour.

This method of preparing a bed of celloidin has been employed with very satisfactory results in obtaining sections of embryo chicks. Blastoderms of the earlier periods of incubation have been successfully sectioned. By arranging the embryo on the bed of hardened celloidin it has been possible to get large symmetrical sections of the blastoderm. Celloidin contracts during the drying process, but, by the exercise of due care in arranging the blastoderm, distortion may be avoided.

This method of imbedding has given good results in studying hydra, and the preparation of the celloidin bed may be resorted to in almost every case where delicate objects are to be sectioned.

NEW PVBLICATIONS

Artificial Anæsthesia and Anæsthetics. By Prof. De Forest Willard and Dr. Lewis H. Adler, Jr. Detroit: Geo. S. Davis. 16mo, pp. 144. 25 cents.

The authors say that their manual is intended to be complete in detail as far as important facts are concerned, and to be a *résumé* of the uses, the abuses, and dangers of each anæsthetic substance. These objects seem to be accomplished. Its statements are concise and in the main trustworthy. After a brief historical chapter, the authors treat of the preparing of the patient, methods of administering anæsthetics of ether, chloroform, nitrous oxide gas, less commonly used substances, anæsthetic mixtures, local anæsthesia, and substances, special modes of producing anæsthesia, and the medico-legal relations of artificial anæsthesia, the whole being comprised in twelve instructive and serviceable chapters.

The Supreme Passions of Man. By Paul Paquin, M. D., Battle Creek, Mich.: The Little Blue Book Co. 16mo.

The author seems to think that most diseases and most crimes are caused by mal-nutrition of the cells forming the human animal, and that improper food is at the bottom of all trouble. He says: "Get mankind once under a safe system of nutrition based on science, a system allowing foods only of such kinds, qualities, and quantities, and at such times as nature intends for him, fully seventy-five per cent. of the prevailing diseases and crimes will disappear from the globe, because the cause shall be no more." And although he is not quite ready to recommend a strictly vegetable diet, yet he believes that it "affords all the nutrition necessary for the system, and may offer the easiest path to reach the aim of life and the end of existence in the healthiest and purest manner." It is nevertheless pretty generally accepted by scientific physicians that a vegetable diet will speedily bring about an atheromatous degeneration of the arteries in him that delivers himself over to that method of living.

W. P. Collins' Scientific Book Catalogue, No. 27. 1892.
atalogue is devoted to botany, zoölogy, geology, paleon-
nd petrography. Among the entries are many well-
nerican prints. Cole's "Studies in Microscopical
vith 89 colored plates, are offered at £2 2*s.*, which is
ication price.

·THE·MICROSCOPE·

AN ILLUSTRATED MONTHLY MAGAZINE.

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Impressions of the Antwerp Microscopical Exposition.

BY R. H. WARD, M. D.

President's Remarks at the Microscopical Section of the Troy, N. Y., Scientific Association, Oct. 19, 1891.

GENERAL ARRANGEMENTS.

The first general Exposition of Microscopy ever attempted would be, of itself, a most interesting event, even if it did not enjoy the rare distinction of being a tricentennial celebration of the invention of the compound microscope. Such an exposition and celebration it was proposed to hold at Antwerp, in connection with an International Botanical Exposition, in the summer of 1890; but on account of unexpected difficulties that were encountered it was not opened until last August.

A local executive committee was appointed, and the management was placed in the hands of Dr. Henri Van Heurck, the distinguished microscopist and botanist, and director of the excellent botanical garden at Antwerp. A committee of honor and patronage was also appointed, its members being selected from the various European nations, and also from Cuba and the United States.

The plan adopted, including everything fairly pertaining to microscopy, past and present, was broad enough to suit all comers, and exhibits were solicited accordingly. Unforeseen delays occurred on account, it is said, of the fact that the most important manufacturers, who were expected to furnish illustrations of the modern styles of instruments, being, in fortunate and remarkable contrast to most other businesses, already favored with demands in advance of their capacity for supply, could not well spare any-

thing for exhibition, and did not care to incur the expense of doing so when no direct pecuniary compensation could result. Ultimately, however, the enthusiastic work and magnetic influence of the "*President Directeur*," Dr. Van Heurck, secured an ample representation of continental manufactures, and also a considerable variety of amateur and professional microscopical work.

No adequate participation was obtained from England, which country was represented by only two prominent manufacturers, and a scarcely larger number of microscopists, yet received a liberal number of the higher prizes. In America some interest was taken in the enterprise; but, with the single exception of a few notable photographs contributed jointly by Prof. J. D. Cox and an English collaborator, absolutely nothing was done. The distance would naturally increase the inconvenience and expense of participation; our manufacturers, like those abroad, seem to be fortunately above the need of exhibition as a means of increasing trade, or else they feared that the difference in prices would have prevented sufficient sales abroad to repay the expense incurred. Admitting, from a business point of view, the sufficiency of these reasons, it is still impossible not to regret, as a matter of national repute if not of pecuniary profit, that we could not have been represented. We should not have hoped to compete for the first prize, as it was evident from the beginning that that must go to Jena; but with a reasonable effort we could have expected to take several in the very high grades.

Excellent local arrangements were made. The exhibit was housed in the palatial building of the Athéné Royal. Competent local agents cared for the interests of non-resident exhibitors, at a reasonable cost. The greatest courtesy was shown to foreign visitors, and unlimited opportunities were offered, to those known to be competent, for examining every thing at their own pleasure. Nothing could be more unjust, according to the writer's experience, than the representations, that somehow got into print, that the articles could only be seen in glass cases.

A series of lectures, illustrated by projections with the screen microscope, was given, during the continuance of the exposition, by Dr. Van Heurck and his associates; and occasional concerts furnished entertainment to the visitors, and improved the financial situation at the ticket office.

Probably most visitors were disappointed, at first sight, at the smallness of the exhibition. It was difficult to wholly throw off the feeling that an international exposition ought to be a great fair, extending through a large number of rooms. But it soon evident that a great microscopical exhibition need not very large space. The display grew with familiarity, ally presented itself as an interesting and instructive

demonstration, chiefly of continental microscopy, too large to be seen satisfactorily in many days, or, when seen repeatedly, to be remembered in its details as one would wish. Few persons interested in the microscope could have spent two or three weeks in serious study of the exposition without being amply repaid both in pleasure and in profit; while they would certainly have enjoyed, meanwhile, a delightful visit in the quaint and charming town.

Historical Exhibit.

Amidst the chaos of instruments displayed, a thoughtful person naturally turns first towards the historic exhibit, and especially to the one microscope of unique claims and interest, the only known original by Hans Janssen or his son Zacharias, who are claimed to have invented the instrument in or about 1590. Upon this claim rests the character of the exposition as a tricentennial, and to the memory and honor of these modest Dutch spectacle-makers the enterprise was officially dedicated in the form "To Hans and Zacharias Janssen, of Middelbourg, inventors of the compound microscope, on the occasion of the 300th anniversary of their admirable invention, the first cause of the most important discoveries in the medical and natural sciences." The Janssens must have experimented upon a variety of forms, as was most natural under the circumstances. Their instruments have commonly been described as tubes of gilded copper, one inch in diameter and six feet long, being, probably, telescopes converted into compound microscopes, supported by dolphin-shaped pillars over an ebony base, on which rested the object to be examined. One of these is said to have been carried to England about the year 1590, and to have been shown to William Borrell and others. Very different and far more crude is the "*microscope authentique de Janssen*" contributed to the exposition by the Zealand Society of Sciences. This consists of rough tin tubes, soldered, about two inches in diameter, and, when combined as a microscope, some 12 to 14 inches long, containing an ocular and objective, each consisting of a single lens of about three inches focus. It has no stand, but is held in the hands and aimed, telescope-fashion, at the object, which it magnifies from 0 to some 5 or 6 diameters, according to the extension of the tubes. Though very rudimental, roughly fitted, and to our ideas, absurdly inefficient, it is still evidently a microscope, and none the less so if it was originally an experiment in telescope-making. Therefore, conceding its genuineness, which, though attacked in the interests of other claimants, does not seem yet to have been successfully controverted, and that its maker was aware of the possibility and effect of focusing it upon near objects, which is so probable as to

be practically certain, this instrument takes rank as the earliest compound microscope yet known; it carries the invention back from the 17th to the 16th century, from Italy to the Netherlands, from Galileo (already rich in honors) to Janssen, and it vindicates our exposition as a tricentenial.

A cut of Janssen's Microscope may be seen in the "Cantor Lectures on the Microscope," p. 7.

The remainder of the historical exhibit presented an interesting variety of the curious and often fantastic constructions of the 17th, 18th and early part of the 19th century. Their optical parts were so primitive and inefficient as to impress one, at the present day, with great respect for the intelligence and perseverance of anybody who succeeded in doing any useful work with them. Their stands were clumsy and often grotesque, many having wooden bases and huge bodies of wood or pasteboard covered with paper or leather, and often highly decorated with chasing or paint or gilt, the whole appearance being suggestive of the cabinet-maker's and bookbinder's rather than of the optician's art; and the brass-work, what there was of it, followed the fashion of the centuries, running into scrolls and dolphin or dragon forms and ingenious elaborate devices instead of the severe practical utility of the present day. Many of the instruments were focused by screwing the whole body down with a very coarse movement, through the collar which supported it, toward the stage; a method revived in fine brass-work in the clinical microscope of Tolles a few years ago. The chief individual exhibitors in this department were Dr. Van Heurck, of Antwerp, and A. Nachet, of Paris, both of whose collections were large and attractive.

Among the instruments most interesting for personal reasons were three genuine microscopes of Leeuwenhoek (1673), which had been used in his studies by that pioneer in histology, and were exhibited here by an artist painter (P. A. Haaxman), of Delft, a lineal descendant of Leeuwenhoek's sister; also an authentic simple microscope of P. Lyonnet, accompanied with the dissecting instruments he used with it in his famous study of caterpillars, and by the numerous plates engraved by his own hand (Maastricht, 1760), contributed by the Royal Zoölogical Society of Amsterdam; a fine compound microscope presented to Buffon by his pupils (inscribed "*à notre maître par ses élèves*") in 1758, having a wooden base with three knobs to give a tripod effect, with a stout body, some 3 inches wide and 7 long, supported vertically by heavy brass-work and supplied with coarse and fine adjustments; and a microscope by Amici, that formerly
d to the botanist Schleiden (1837).
ves aside from the regular outfit of the various mi-
re were globules from melted glass of 1750 and 1815;
and of sapphire, by Charles Chevalier (1825):

and an archromatic objective by Beeldsnyder, an amateur in Holland just 100 years ago (1791). This objective, exhibited by Dr. A. W. Hubrecht, professor of zoölogy in the University of Utrecht, is claimed to be the first one made, and is so well constructed as to give a very good image. It consists of two convex lenses of crown-glass, with a biconcave of flint between them, and appears to be the earliest known adaptation of the achromatic telescope object-glass to the microscope, which was revived unsuccessfully at Modena by Amici in 1812, and successfully modified and introduced at Paris in 1823.

A most interesting example of an ancient cabinet of slides was a systematic collection of 300 preparations (18th century), in ivory slips, four specimens in a row in each; the objects were mounted in holes bored through the slips, they and their covers being held in place by wire rings sprung into the cell and upon the cover. Interesting preparations by Andrew Pritchard were also shown (London, 1825).

Microscopes and Accessories.

In this department the chief exhibitors were, naturally, the manufacturers, and with only two notable exceptions they were of the "continental" group.

Among the whole it was evident that one, the Carl Zeiss establishment at Jena, was easily pre-eminent, on the account of the magnitude and variety of its exhibit, the high quality of its work, and the extent and importance of its contributions to the recent development of the microscope, especially in inventing and introducing new optical glasses of high refractive indices and in the creation of the apochromatic objective. The exhibit included a large variety of the well-known Zeiss stands, with their different classes and powers of oculars and objectives, and their outfit of numerous and ingenious accessories; also a special stand for photomicrography, a complete special photomicrographical apparatus that is small and portable, and another of great size furnished with a Schuckert electric lantern and the most elaborate appurtenances of various kinds. But the most interesting feature of their exhibit was a demonstration of the construction of a large stand and of an aprochromatic objective and a compensating ocular. All the pieces entering into the construction of a No. 1 stand were displayed spread out in a case, like a picture against the wall, each piece being given in duplicate, once in the rough casting or section of tube or wire, and again in the finished form ready for assembling into the completed instrument. In another case were superb blocks of the new optical glasses of Drs. Abbe and Schott of Jena, and of the fluorite of the Oltscheren Alp. The different stages in the construction of an 8 mm. apochro-

matic objective and of a compensating ocular were also displayed in proper series, all the lenses entering into the combination being shown both in the rough and the finished state. Probably every visitor would have voted with the jury in awarding the one special prize, the diploma of pre-eminence, to the Jena company.

Next to this, three grand prizes were given, which went to London, Paris, and Germany, respectively. The English one was bid for by a solitary stand, with two or three objectives and condensers at its feet, that looked so lonesome, not to say insignificant, that to claim a leading prize for it seemed almost presumptuous. Its appearance, amidst the neighboring cases crowded with showy apparatus, suggested at once the quiet home from which it came in Euston Road, in contrast with the showy shops where such goods are commonly displayed. But the stand made a strong competition for its not too modest claim, to be the most perfect that is made, the apochromatic objectives were judged to merit their high reputation, and the apochromatic condensers were found to give a singularly perfect illumination, and a "*grand prix*" was awarded to Powell & Lealand.

Prizes of like grade were well earned by, and awarded to, A. Nachet of Paris, and to E. Hartnack, originally also of Paris, but since the Franco-German war, now of Pottsdam, Germany, both of whom exhibited a large variety of apparatus of the very highest grade, including excellent apochromatic objectives and sumptuous photomicrographic apparatus.

Of the many creditable exhibits of a somewhat more modest grade, at least in respect of prices, by far the largest was that of Wm. Watson & Sons, of London. In fact, it was one of the most interesting and commendable features of the exposition. It stood alone, except for the single P. & L. stand, as the sole representative of the English ideas and styles, while everything around it was continental, wholly continental. These makers, also, in developing some of their most practical stands, have made such large and good use of American ideas and experience that we are half inclined to claim a special interest in the result. We have been much interested in their efforts during recent years to develop and improve the simple and less expensive forms of microscopes, especially in rendering the English and American type convenient and available for laboratory use, and in building up in London well-organized shops (after a method characteristic of American practice) where work of a uniformly good quality can be done by machinery at a moderate cost. Perhaps the most universally available of their more ambitious instruments, though fortunately far from the largest or more costly, is the one lately ar-

d from Dr. Van Heurck's suggestions and named after him.

of moderate size and cost, being of exactly the size that

the writer would choose as a maximum, this possesses a great number of serviceable features; and, notwithstanding the unfavorable opinions that some eminent authorities have expressed on theoretical grounds, its practical working seems excellent. The jury especially complimented "the extreme precision of all its movements;" and the writer found it unexpectedly easy with its fine adjustment to focus a lens of n. a. 1.63 upon the shell of *A. pellucida*, adjusting it instantly to exactly the plane of clearest vision of the dots, and leaving it there, though every one knows that, with extreme powers, it is often easy to catch glimpses, in passing, of points which can hardly be permanently focused upon and shown to other observers.

One of the strongest and most agreeable impressions made by the manufacturers' exhibit, in the aggregate, is that of the uniformity in good workmanship, and of the variety of convenient and tasty designs, by all the prominent makers.

All the manufacturers, with two exceptions, already stated, are of the continental sort, and never before has the writer seen grouped in one room a representative collection of their microscopes at all comparable to this. It is most interesting to note the purity in which, in so many hands, their type of stand has been preserved and the extent to which its possibilities have been developed. This style must be abundantly satisfactory, alike to the manufacturers and to their patrons, to be so freely reproduced and elaborated by so many ingenious workers, in so many diverse places, with so little deviation from the prevailing type. The interest of the display is doubled, to Americans, from the fact that from the first we have been constantly presented with the choice between adopting the English or the continental style as the basis of our own. The friendly though often severe battle of the stands has continued throughout the memory of the present generation, and still continues to some extent notwithstanding the evident fact that the English type has entered by far the most largely into our experience thus far. Without forgetting that where the wisdom and experience of continents are concerned, the opinions of single individuals are of little importance, the writer could not do justice to the title of this paper without giving his "impressions" on this very interesting phase of the subject. While a user of the English style for more than thirty years, and naturally with strong prepossessions in its favor and still satisfied with it, he must admit that the neat and unpretentious continental stands of the smaller and more simple grades become more attractive with every increase of acquaintance. It would be difficult to find anything more tempting or practical for student's laboratory work (exclusively) than the beautiful little stands exhibited by all the French and German makers, though some of the small American and English stands still seem to be equally

available. On the other hand, the larger stands of the continental type, with elaborate adjustments and numerous accessories, always produce the feeling that, notwithstanding their ingenious designs and great efficiency, they are unfortunately clumsy and somewhat overloaded, their traditional compactness being maintained at the cost of some unnecessary inconveniences. The possibilities of the English-American stand seem to be not yet realized on the continent; but the writer will venture the prediction that there will be a revolution in this respect some time before the next tricentennial. The reaction has evidently commenced already in respect of accessories and incidental refinements of detail. Such microscopical aids and comforts as mechanical stages, elaborate sub-stages and sub-stage condensers, iris diaphragms and rapid nose-pieces, which we have been using for a generation, more or less, with great satisfaction, but which we have meanwhile heard constantly denounced by partisans of the continental method as needless luxuries and distracting toys, all these we now see introduced and given a proper prominence by the best continental makers. 'Tis well.

As to objectives, the progress of the present day evidently centers around, or stands in comparison with, the apochromatic system. Of the success of the system there is no longer a reasonable doubt, either as a scientific or as a commercial question. Characterized by the employment of new varieties of glass, of extraordinary optical properties, manufactured at Jena, and by the substitution of fluorite (natural fluor spar) for crown-class in several of the lenses, it corrected spherical and chromatic aberration to an extent not before attained. Brought into existence by the researches and experiments of Abbe and Schott, and first successfully introduced at the Zeiss factory, in 1884, it is now adopted for their highest grades of objectives by all the above-named makers except perhaps Watson; and new series or varieties are being constantly introduced.* The resolution of *Amphipleura pellucida* in dots, which has been ably disputed and may be still doubted by some competent judges, is well within the limit of their capacity. The writer was fortunate in being afforded the rare privilege of witnessing the official trial of the objectives by the jury, at which time the Zeiss 1-10th (2.5 mm.) of n. a. 1.63 with monochromatic sunlight illumination, showed the dots (or "beads") with beautiful distinctness and with perfect ease. They were seen at a glance over a large part of the shell at once, always alike and with remarkable freedom from any suspicion of uncertainty; and when lost by change of focus, or even by carrying the instrument to another table and readjusting the light, they

*Near the close of the exposition, after the report on awards was adopted and closed, a new 1-12th (2 mm.) was received from Nachèt and informally examined by the jury, with the result of calling out from them a special note of commendation.

could be recognized instantly, and every time, by simply correcting the fine adjustment. As the most oblique pencils able to be utilized by this objective, as employed, ought, according to the Helmholtz theory, to be able to resolve lines of about 6,000 to the millimeter, and as the *A. pellucida* had about 3,700 rows of the dots transversely, and 5,000 rows longitudinally, to the millimeter, this resolution, while near enough to the theoretical capacity of the lens to give an impressive demonstration of a near approach to perfection in the construction, yet does not, by exceeding its theoretical capacity, throw discredit upon either the genuineness of the resolution or the accuracy of the optical theories involved.

But the durability of the apochromatics is, most unfortunately, not equally plain. It is said that those first made were unsafe, from the ease with which changes occurred in the frail phosphate and borate glasses causing the dimness known as the disease of the apochromatics. This was always freely corrected without charge by the makers, and it is believed that the glass as now made is free from this defect. The fluorite, however, must be taken with its natural defects; and its easy cleavage renders it very fragile. In fact, it is now known that, more than thirty years ago, Charles A. Spencer, of Canastota, N. Y., recognized its tempting optical properties, and used it in the construction of objectives, one of which is still in existence; and that he abandoned the method because of the early deterioration from the cracking of the spar. That now used in the apochromatics is not only clearer and remarkably free from color, but is evidently more durable, and, it is hoped, practically permanent. The lenses are, however, absolutely limited in output, as the world's supply of suitable spar is confined to the stock now in hand, with no known means of replenishing it. It is, therefore, none to soon to be finding some method of making high-class work without it; and this is being attempted, with encouraging success, by several makers, in the construction of the semi-apochromatics, made from the new optical glasses, but without the fluorite. Though not quite as free from color as the apochromatics, their veiws are very distinct and their working qualities extremely good. The resolution of *A. pellucida* in "beads" by a semi-apochromatic is claimed to have been accomplished in Italy.

Illuminating Apparatus.

Though made a separate class in the official announcement of the exposition, most of the illuminating expedients were necessarily merged in the exhibits already mentioned. The recent remarkable development of the substage condenser, as an inevitable result of the adoption of the apochromatic objective, was seen everywhere. Powell & Lealand submitted their dry apochromatic condenser of n. a. 0.95, able to work through common

slides and especially adapted to photomicrography, and their apochromatic homogeneous immersion condenser, of n. a. 1.40, for special researches. The Abbe condenser, now made also in an achromatic form by its original producers, the Zeiss house, is universally adopted by the continental makers.

The only special exhibits in illumination worth mentioning were in the use of electricity. Dr. H. Van Heurck, for ten years an enthusiastic advocate of this method, exhibited the various devices he has employed. He believes that the incandescent light, while possessing the mildness of the petroleum lamp, excels it and nearly equals monochromatic sunlight in the power of showing with clearness fine details like the markings of *Amphipleura* or the 19th band of Nobert's plate. This is believed to be due to its greater intensity, enabling sufficient light to be obtained from a very small pencil of rays, and to the greater proportion of the shorter waves of the blue and violet end of the spectrum, which gives its peculiar whiteness to this light. In view of these advantages it is to be regretted that this light, though perfectly attainable with the now available apparatus, has not yet been able to compete successfully, for general use, with the more convenient petroleum lamps.

A remarkable collection of batteries, dynamos, and lights suitable for microscopical use was exhibited by the great French electrician, G. Trouvé, of Paris. His "photophore," consisting of a little drum containing a bull's-eye lens with a tiny electric loop behind it, the whole sliding easily up or down a vertical pillar and capable of turning at any angle, like the search-light of a ship, seems by far the best electrical illuminator yet produced. It apparently needs only to be freed from its dependence on the necessarily troublesome battery by the presence of an electric service-wire in every house to become *the* illuminator of the microscope. By this exhibit, M. Trouvé, whose biography, lately published in a fascinating book as "The History of an Inventor," seems more like a romance than a history, added another diploma of honor to a former list of awards of which any inventor in any line of research might well be proud.

Photomicrography.

This class was, of course, exceptionally prominent. The apparatus pertaining to it was mostly included in the makers' exhibits of microscopes and accessories.

A. Nachet, of Paris, whose personal experience in photomicrography insures a special interest in the work and an exceptional familiarity with its demands, was first in the variety of his appliances and unsurpassed in their quality and completeness. His "grand apparatus" has a horizontal bellows capable of easy adjustment for distances up to about two meters. The stand is

placed horizontally in connection with this; but it has also an extra body branching vertically from the main body, just behind the objective, and supplied with a sliding prism which serves, when racked down, to totally reflect the light from the objective up through the vertical tube which is used for observation while adjusting the object and the illumination, and when racked up permits the same pencils to pass horizontally directly to the sensitive plate at the far end of the bellows. His "petite apparatus" designed for elementary work is very simple, the dark chamber being a plain box supported over the ocular end of an ordinary microscope standing either vertically or inclined. This box, with its sensitive plate at the top, can be clamped at various heights upon a pair of parallel supporting bars, the latter being jointed at the level of the microscope stage, so that they may be maintained parallel with the body at any desired inclination. His mammoth style of "inverted microscope" (which will be remembered as a conspicuous feature of his exhibit at our Centennial exhibition at Philadelphia in 1876) is also fitted with an inverted dark chamber which is supported upon the top of the inclined tube, and which, with such a support, has naturally the advantage of extreme steadiness. But Nachet's most unique device is the apparatus for instantaneous photography of living objects, as infusoria, etc. This is an elaborate and finely-built affair. The inverted dark chamber is supported upon pillars, several feet above the body of a vertically-placed stand with which it is connected by means of a bellows-tube in the form of an inverted pyramid. An ingenious reflecting arrangement enables the observer to examine most conveniently the image on the focusing plate above his head. An extra body branches obliquely (after the Nachet fashion) from the side of the ordinary one, and, by aid of a sliding reflecting prism, is used for adjusting and examining the object until the instant when a picture is required, at which time a sudden movement of the prism allows a momentary flash of the microscopical image upon the sensitive plate. The writer did not see this very ingenious apparatus in operation; but it is said by competent authority to work perfectly with electric light or direct sunlight.

Superb photographic outfits were likewise displayed by E. Hartnack of Pottsdam, the Carl Zeiss house of Jena, Carl Reichert of Vienna, Ernest Leitz and W. & H. Seibert, both of Wetzlar; and scarcely inferior ones by other makers. Most of the makers show two styles corresponding more or less to the first two Hartnack styles above mentioned; one horizontal and elaborate, for long distances, and a simpler form inverted and vertical or inclined, for short distances of less than about a meter.

Special photomicrographic stands, with bodies wide and short, are shown by Zeiss, Reichert, Watson (the Van Heurck stand), and others. Several manufacturers also present special objectives,

or illuminators with heliostats, lime-lights or electric lanterns, well adapted to this work.

Photomicrographs in great number and variety and of every degree of excellence were displayed upon the walls and crowded in the cases not only of the main hall but also in a separate room devoted to them.

Thirteen prizes, of several different grades, were awarded in this department. The first of these would certainly have been voted to Dr. Van Heurck for his photographs of diatoms, on account of the clearness and general excellence attained in treating subjects chosen for their extreme difficulty; but, though not a member of the jury of awards, his prominent connection with the enterprise as the originator of the exposition and the leader of its management led him, with very good taste, to decline to be considered a competitor for any prize.

One grand prize was awarded, to Dr. Giorgio Roster of Florence, who exhibited four dozen extremely fine photographs of natural-history objects, including diatoms, and of pathological subjects. These were models of good photography and mounting and of scholarly labelling and arrangement.

Four diplomas of honor followed: one to Prof. J. D. Cox of Cincinnati and Mr. C. Houghton Gill of England, who conjointly with Dr. Van Heurck exhibited a number of diatom photographs, magnified from 500 to 1,500 times, displaying the structure of the shells in a decisive manner by means of edge views of broken fragments of valves with their areolæ filled in with silver sulphide, mercurous sulphide, or platinum; one to Mr. Andrew Pringle, and one to Mr. Thomas Comber, both of England, for fine diatom photographs; and one to F. Thévoz & Co., of Geneva, for a large and excellent variety of "phototypes," impressions suitable for book illustrations, from photomicrographs of diatoms, infusoria, microbes, and natural-history objects generally.

A novel and remarkable series of photomicrographic transparencies suitable for the magic lantern was shown by Antoine Lumière & Son, of Lyons, France. The gelatin bromide of silver transparencies were cleared and stained, by some process claimed as original, so that the color of the object as seen in the field of the microscope was exactly reproduced. Thus desmids, for instance, were stained a natural green, while microbes, animal tissues, or plant sections, which are usually stained for the microscope, were colored to correspond. The transparencies when held up to the light, or displayed by hanging in the windows, represented vividly the field of view in the microscope itself, and in the magic lantern or with a sufficiently low power of the projection microscope they produced that effect well upon the wall. At a lecture in the amphitheatre many of these views, including a series representing

the embryology of the chick, were projected upon the screen with good effect.

Several collections that were not remarkable as photographs were interesting, and perhaps even more valuable as demonstrations of natural history or of economic science, and as examples of thorough and useful scientific work. Such was the comparative study of the structure of oily seeds by Director Fréd. D'Hont and Mr. F. Moreau, of the communal laboratory at Courtrai, Belgium, illustrated with six large frames full of photographs (x 100), and with a side case displaying a set, complete in every detail, of the few simple instruments, reagents, etc., used in the investigation. A somewhat similar study of the comparative histology of the seeds of the cabbage, mustard, flax, and other plants of commercial importance was shown by Director Paul Claes and Mr. Émile Thyes of the state agricultural laboratory at Louvain. Mr. Ed. Anseel, of Antwerp, likewise exhibited a set of three dozen views, adequately magnified, demonstrating the character of the hairs of different animals. It would be difficult to commend too highly the educational and economical value of this class of work.

Bacteriology.

The two principal exhibits in this class consisted of extensive selections from the vast variety of apparatus made by E. Adnet and by V. Wiesnegg, both of Paris. The sterilizing and incubating ovens, baths, furnaces, and lamps, stills, filters and refrigerators, and the large variety of associated apparatus constituted exhibits of exquisite work in brass and copper and glass that were among the most showy as well as instructive in the exposition. To attempt a description would be to discuss the late progress in the whole prolific specialty of bacteriology, and would fill a book.

But the most remarkable exhibit in this class, and the only one which very worthily took a grand prize, was that by the city of Paris, which presented, crowded upon a line of two-story tables in the middle of the hall, a demonstration of the famous work in the biological analysis of air at the municipal observatory at Montsouris. Not only was the great variety of ingenious apparatus displayed, but the methods of combining and using it, and the results attained, were shown as fully as possible. The publications of the observatory, and of the director, Dr. Miquel, were also presented, and secured a well-earned gold medal for Dr. Miquel.

Preparing Apparatus.

The principal microscope makers exhibited, of course, the usual variety of dissecting, or, according to the better continental phraseology, preparing microscopes. The most important general exhibit that seemed to belong mainly in this class was by

Rud. Siebert, of Vienna, who displayed a variety of fine laboratory apparatus, among which the delicate glassware was notable. He also exhibited bacteriological apparatus, mostly of the smaller sorts, in great perfection and variety.

Microtomes and their accessories formed two special exhibits of nearly equal size and interest, by R. Jung, of Heidelberg, and C. Erbe, of Tübingen. Both of these exhibits covered a wide range, from the magnificent and costly machines capable of cutting very large sections with the greatest delicacy, to the smaller and simpler affairs that were carefully contrived and well made and efficient for the general use of students. Both of these makers received diplomas of honor, the medium models of Erbe being especially complimented for their combination of fine workmanship and moderate price.

Of the microtomes offered by the general manufacturers, those by A. Nachet, of Paris, and Chas. Reichert, of Vienna, were most remarkable.

Microscopical Preparations.

Perhaps the most famous professional preparer of objects is J. D. Moeller, of Wedel, Holstein, whose type slides of 400 diatoms have long been familiar. In addition to a varied selection of excellent diatoms and other mounts, he exhibited his greatest and incomparable production containing at once 4,030 diatoms systematically arranged and accompanied by an atlas of 59 folio plates illustrating the different portions of the preparation.

Scarcely, if at all, inferior in scientific or commercial importance, were the large and varied exhibits of excellent slides by Edward Thum, of Leipzig, and J. Tempère, of Paris. The last named preparer, a series of whose instructive preparations was selected for projection upon the screen to illustrate lectures in the amphitheatre, showed comparative slides having six different kinds of blood, or of wood sections, etc., ingeniously and conveniently grouped and labelled on one slide.

Dr. Joseph Montaldo, of Turin, exhibited a large and fine collection of slides illustrating wood-structure; and Drs. M. and Ad. Jolles, of Vienna, contributed a similarly valuable study of food-substances.

Even more notable, though out of competition for the prizes, was the collection of 10,000 preparations by a member of the jury, Prof. H. Bolsius, S. J., of the theological college at Louvain. These slides represented in serial sections (with also a resultant monograph) a study in the anatomy of the leaches, the whole being, to say the least, one of the best examples of individual work in the exposition, and offering to every visitor an instructive and inspiring model of good work in laboratory biology.

Mr. Julien Deby, of England, received a gold medal in rec-

ognitoin of several series of preparations showing thoughtful and able study of interesting subjects mostly connected with insect and plant life.

A notable feature of the exhibition was the free use of the 3x1 in. slides by continental preparers, in preference to the various so-called continental sizes. If confined to professional preparers this might be considered a concession to the requirements of English and American buyers; but being noticed also in the work of those who prepare for their own use, it goes far toward indicating that, in spite of its well-known minor disadvantages, the 3x1 standard was not a very undesirable selection.

Literature.

The invitation for an exhibition of microscopical books secured only a few responses. The owners of valuable volumes are loth to be separated from them for months; and the possessors of priceless rarities of this kind would seldom care to trust them in a public exhibition where to be of any real use they must be handled freely by the visitors. Of modern publications, only the two French journals and a limited number of books and pamphlets on the microscope, diatoms, botany, etc., appeared.

One of the smallest and most unpretending of the works was certainly one of the most remarkable; a little book on "*Sept Objects Regardés au Microscope*," by Dr. E. Giltay, professor of botany in the National School of Agriculture at Wageningen, Holland. The seven objects are: 1, colored lines on opposite sides of an object slide; 2, a cylinder of smoked glass; 3, starch; 4, air bubbles; 5, milk; 6, collenchyma; 7, an Abbe diffraction plate. In describing very plainly and briefly the study of these simple objects a great amount of valuable information is introduced concerning microscopical manipulation, observation, and interpretation. Small as this book seems, it is actually only half as big as it looks, every second page being a duplicate, repeating in French the substance of the opposite page in Dutch. In this very practical way the little book appeals to a greatly enlarged circle of readers.

Among the larger exhibits were several works by Dr. Wm. Behrens; and seven volumes by Dr. J. Pelletan, of Paris, in addition to the fifteen volumes of his "*Journal de Micrograpie*," the whole representing an extraordinary amount of able work.

Dr. Henri Van Heurck exhibited the four editions of his treatise on the microscope, the two grand volumes of his "*Synopsis des Diatomées de Belgique*," with its atlas of 3,100 figures, and seventeen pamphlets. These, in connection with his large collection of interesting antique microscopes, his apparatus for electric lighting, for photomicrography, for micrometric ruling, etc., his unsurpassed photomicrograms of diatoms and other test

objects, and his preparations of type specimens of the diatoms of Belgium, on which his "synopsis" was founded, rendered him by far the most important exhibitor at the exposition. The fourth edition of his book on the microscope was brought out on this occasion, and it was so freely rewritten from the former editions as to be essentially a new book. The modern optics and present construction of the microscope are adequately discussed, the latter, naturally, most fully from continental experience. The general management of the microscope and preparation of objects is included, photomicrography and the staining and slicing of tissues having prominence according to the fashion of the time; but the application of the microscope to the study of plants, and especially of diatoms, is omitted, to appear as a special volume hereafter. Desiring to make the present volume worthy and able to serve as a "*livre de luxe*" commemorative of the occasion without the natural impediment of a proportionally high cost, the accomplished author secured its publication in a grand volume at his own expense, and had it sold at a price that could scarcely be believed to cover the cost of printing. Even to those fortunate enough to have received the beautiful "diploma of honor," this souvenir volume by Dr. Van Heurck will be second to nothing as a keepsake of the Antwerp Exposition.

DETECTION OF CRIME.

The Microscope and a Hair.—Two different men were suspected of making an assault but no proofs were forthcoming. A single hair which was found on the clothes of the victim finally became the clue to the mystery.

The hair was photomicrographed and compared with photomicrographs of the beard and hair of each suspect. There was entire lack of similarity and the case was about to be abandoned. The hair was pointed and had never been cut. Other facts pointed to its belonging to a smooth-haired and comparatively short-haired dog. Inquiry revealed the fact that one of the suspects owned such a dog. A fresh hair agreed in every respect with the specimen. The owner of the dog could not explain away the facts and was convicted. He also confessed to have committed the assault.

—o—

Marshall's Zoophyte Trough.—This life-cell is made by ing any sized circular cell to a slip, and cementing over one- his cell a semicircular piece of thin glass. It can then be ordinary trough when inclined, or as an open cell lat.

Esoteric Beauty and Utility of the Microscope—IV.

By EPHRAIM CUTTER, M. D.,

NEW YORK, N. Y

Asthmatos Ciliaris and Grip.

Epidemic influenza, or grip, is not a new disease, but it varies in prevalence as any other disease. American microscopy has furnished views of grip which are positive and tangible.

In 1877, June 20, I was in Cleveland, Ohio, studying the causes of disease with Dr. Salisbury. He had the grip and showed me under the microscope in his excretions from the air-passages—

(*a*) A dead infusorium called asthmatos, and mentioned in Kents' Infusoria, p. 466, and the Micrographic Dictionary, 1883, as a genus of cilio-flagellate infusoria. *Characters:* free, rounded, with an anterior bundle of cilia and a flagelliform filament. A cilium's length 1=1200 (Salisbury).

(*b*) A living lively and mature specimen that died under our sight.

(*c*) Several young ones which were globular, provided with beautiful cilia, whose motions were as follows:

(1) Some rotated on their own axes, because of the graceful waving backwards and forwards of the cilia moving together like flails beat in unison.

(2) Some where the wave motion of the bodies was less than the motion of the cilia.

(3) Some had an asynchronous movement of cilia; that is, while one cilium waved to the right another was waving to the left, and so on. In other words, the cilia did not move together, but waved independently, and moved symmetrically. The cilia were not arranged in straight lines or side by side, but were planted as trees come up on a conical or rounded hill. Size was on an average about that of the oral mucous corpuscles, which show the so-called Brownian movements. The cilia were as long and longer than the diameter of the globular body. He spoke doubtfully of them, and was not sure of them until the microscope revealed a few of them in the field. He said that sometimes the field is full of them in full activity, and so I have found them. Since this observation many others have been made and published, confirming it. The following additional motions have been observed:

(*a*) A specimen has been seen to turn completely over, so that the cilia faced in opposite directions, and then to turn back again to the original position.

(*b*) They have been observed to bud.

(*c*) To divide by fissure.

(*d*) To have a parturition of a young one which moved from one side of the mother to the opposite, and then issued a new being.

(*e*) A bud of about one-fourth the diameter of the mother would pull off, taking with it a filament of the parent substance, so that mother and young were connected as with an umbilical cord. They would continue to separate more and more, the filament or gubernaculum growing more and more attenuated until it broke. The part attached to the mother was drawn into her. That attached to the young one was drawn into it. They separated as if forced apart by some one as candy is pulled by the confectioner. Prof. Paulus F. Reinsch, of Erlangen, Germany, saw this phenomenon with me, and said it was a new observation in genesis.

(*f*) Besides these, the asthmatos locomote sometimes from one part of the field to another, and in opposite directions to each other.

The best time to collect the forms is in the first stages, when the coughing and sneezing are on. Later it is more difficult to detect the asthmatos, as they seem to penetrate to the deeper air passages, to the maxillary antra and to the frontal sinus even and are more difficult to dislodge. Still they leave behind irritation after they have relinquished the outer air passages. Usually they are more abundant in the clear, glairy, transparent mucus than in the darker and whiter excretions.

How to collect them.—I use the following modes:

1. Place the specimen of sputum on a slide and spread it out in a thin film. Examine under a $\frac{1}{4}$-inch objective which has a working distance of $\frac{1}{8}$ inch at least. I like a large cell, say 2 inches by $\frac{3}{8}$ inch. Mine is of brass on glass. Any one can make a cell by heating sealing-wax and moulding it into a cylinder about $\frac{1}{8}$ inch in diameter, long enough to be laid in the above size on a slide. If then this slide is gently heated from below so as to melt on the sealing-wax all round, the cell will be complete.

2. If immersion objectives or the clinical microscope are used, a cover is needed and the extra excretion removed by a bibulant, as cloth or paper. I prefer the light from a good adamantine candle or oil lamp. Mode one grows the largest field at once and saves time. Higher objectives may be used. I have photographed the asthmatos with the one-sixteenth and one-seventy-fifth inch objectives and demonstrated to many people. It is not now denied that these forms exist in grip.

What has been said to me about them.—

1. "Pshaw! No such thing as a cause of grip." This was uttered by an old physician in the full tide of a large practice, who has to treat the grip without microscopy, and so spoke from personal observation. He knew nothing about infusoria, nor wn success in reaping the monetary rewards of his ife could he think it needful for him to know.

d that the forms called asthmatos were deformed . This narrows down the question to asthma-

tos versus ciliated epithelia. One gentleman showed me a French physiology where these forms were figured as deformed epithelia found in the grip (*la grippe*). Dr. Leidy, in 1879, came out and took the same position and gave figures of the forms he had observed in the excretions of patients. These statements were enough to satisfy them and those who did not use the microscope in favor of ciliated epithelia deformed.

3. Some years ago an eminent physician said he had seen an infusion of grass under the microscope and these were just such forms as were figured in my cuts. He said that grass infusion probably had been mixed with the excretions.

4. I was called to see a child two years old said to have lung fever. Face red and countenance expressive of great suffering; incessantly and noisily coughing and raising; body hot; pulse normal; breathing normal when not coughing. From the pulse and respiration I doubted the pneumonia. Down her upper lip ran considerable thin, acrid, watery mucus from both nares. Some of this I scraped off, and by aid of the clinical microscope at once found it swarming with asthmatos ciliaris. I used an atomized saturated watery solution of the benzoate of soda. The case recovered sooner than I wished for. I was anxious to study the unusually lively forms. When I stated this at a medical society, a brother physician took the ground that these forms were ciliated epithelia, and said he had a slide with some that he had taken that day. He said: "Mr. President. I would show them, but I have no microscope." Said I: "Mr. President, I have a microscope, which is at the gentleman's service." Said he, addressing me: "Your microscope is not good for anything, and I can't use it." Said I: "Please let me try for you." I took my clinical microscope with a one-tenth (1-10) inch objective, four systems, 180° angular aperture, made by the late Robert B. Tolles, and found the forms the doctor alluded to. I then handed the microscope to him and he made believe that he looked, and said: "Mr. President, I can't see anything." I replied: "Mr. President, I can, and I can furnish microscopes, but not brains."

Why I believe in the asthmatos and regard the treatment of grip based on this belief as one of the most beneficent and useful American uses of the microscope:

(*a*) The asthmatos is not found in ordinary colds. Ciliated epethelia are. Others may, but I have never found deformed ciliated epithelia in motion of body.

(*b*) I was never taught that there were ciliated epithelia deformed. With this exception, including observation above named, I never was taught that ciliated epithelia resembled the asthmatos. If these forms are deformed epithelia, why should it not have been taught to prevent mistakes on my part?

(*c*) The asthmatos has been found on the mucous membrane

of the eye-ball of people suffering with grip. If these forms are deformed ciliated epithelia, why have not medical schools taught that they are found on the human eye-ball?

(*d*) The asthmatos are reproduced by budding, fissure, gubernacular method and parturition. I know of no authority for such reproduction of deformed ciliate epithelia.

(*e*) The fact that the Philadelphia savans found forms like the asthmatos in infusion of grass shows a strange habitat for deformed ciliate epithelia human. I am aware of the great viability of human epithelia in hydrant waters and have often observed them there, but never have I found ciliated epithelia. I have searched in hydrant waters of about thirty cities and towns and in the canals of the Netherlands for the asthmatos but never found one that I felt sure of until August, 1890, in a canal between Haarlem and Leyden, Holland. I have found plenty of moving ciliated epithelia in the juice that laves the mantel of the common marine soft-shelled clam, along with cilio-flagellate infusoria.

(*f*) The most practical evidence to me of the forms in question being flagellate in form and not ciliated epithelia deformed is their behavior to treatment with quinine, salicine, menthol, the fumes of burning sulphur, and nascent chloride of ammoniun.

I have found patients suffering with the grip, and in sputum the active and lively form in question, and made them to inhale the fumes of burning sulphur and seen them instantly relieved of the bad symptoms. Examining the secretion just after the inhalation and relief, I have found like forms in question dead and motionless. If deformed ciliated epithelia are thus affected by burning sulphur fumes, for example, it is something novel in medicine and not taught. So long as I find that grip patients are relieved and cured by killing and removing what I believe to be the asthmatos I shall not cease to be grateful to the Netherlanders for inventing the microscope.

QUERIES AND ANSWERS.

...all sorts relating to microscopy will be received by the publisher and referred ... of Albany, N. Y., whose replies will be given in this department. Each ... for future reference.

...m can be used without heat for mounting

Benzol or chloroform balsam. Glycerine and Farrant's solution are all used cold, and may be had at the dealers'.

56. *Where may I find a reliable description of the differences between an animal and vegetable cell?*

See Carpenter on The Microscope, 7th edition, page 461.

57. *What is the best method for making permanent mounts of urinary crystals?*

Form the crystals on the slip, dry them and mount in balsam.

58. *How may earth worms be preserved for sectioning?*

Keep the worms in a vessel containing wet blotting-paper, for several days, to clean out the intestine; pin them on a slip of wood to keep them stretched; place them into alcohol to harden. Keep them in strong alcohol until they are cut.

59. *What is the method for grinding sections of teeth? What apparatus is needed?*

Cut the tooth into thin slices with a fine saw; rub one of the sections on a scotch-stone with the end of the finger, using water; with care, good sections can be made without other apparatus. The pressure of the finger can be regulated to bear lightly on a thin corner or heavily on a thick edge. Very large teeth should be cemented on a glass slip and ground in the same way. See Microscopy for Amateurs, by T. Charters White.

60. *What is the difference microscopically between Columnar Epitheleoma, Adenoma and Papilloma?*

In brief, to keep within the limits of this column, Columnar eptiheleoma is soft, the margins infiltrate the surrounding tissues; the tubes are fibrillated connective tissue, lined with columnar epitheleum, not intimately attached; large blood vessels in the stroma between the tubes. Adenoma is soft, usually encapsulated; the glandular tissue abnormal, not of the type of the matrix; tubes usually obstructed with cells and irregularly disposed; blood vessels not numerous but are in the tube walls. Papilloma is hard, not infiltrating; is an overdevelopment of the normal papillæ of the part; being inflammatory is very vascular and contains numbers of leucocytes. These latter may simulate infiltration. In cancerous forms of papilloma the large multi-nuclear cells may be seen in alveoli.

61. *What is the best medium for mounting fish parasites?*

Soak them in alcohol, glycerine, and water, equal parts of each, and mount in Farrant's solution, or glycerine.

62. *How shall I mount fish eggs to show structure, also embryo fish? They are now in glycerine.*

These are rather opaque objects and are best mounted in balsam, but few details of structure will be seen, however. Special preparation and teasing are necessary.

63. *Which is the best of the cosin dyes, the blue, red, or yellow?*

Use the red shade, make a rather weak solution in water, wash the stained sections in water containing a little acetic acid.

64. *I have some microphotographs on small glass beads. How may I mount them on glass slips?*

These photos are usually covered with a piece of glass cemented with balsam. Soak in benzole until separated, place a drop of balsam on the centre of a cover-glass, put the bead in the balsam, photo face next the cover; let it harden under a glass shade, mount in a cell deep enough to take the bead.

65. *What are the points of difference between Bismarck brown, vesuvine, chrysoidine, etc?*

Where can I find a description of the uses of oxalate of rosaneline and twelve other aniline dyes named?

What is the difference between the various aniline violets and purples?

What are the points of difference in the various aniline blues?

It would be unprofitable to devote time and space to answer the above queries in full. The literature is scattered and is mostly worthless reports of hasty work. Added to this, the fancy trade names applied to these dyes make identification difficult. The aniline colors are brilliant, but as a rule stain diffusely, fade quickly, and have a restricted value for temporary study mounts. A real service would be accomplished if some one would procure authentic specimens of these colors, make a large number of stainings and report, after a year, in some prominent journal.

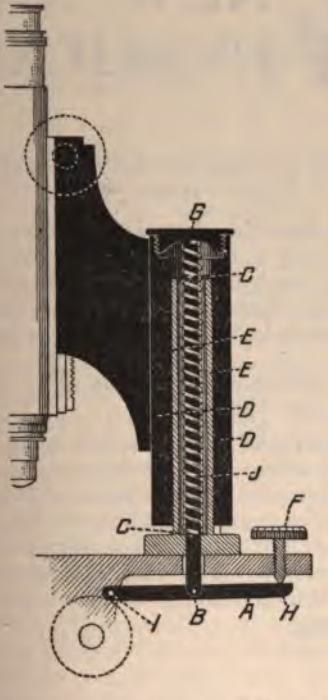
The *Am. Mo. Mic. Journal*, vols. VI and VII, contains a series of translations from the German of Hans Gierke on staining tissues, valuable and full.

66. *Will you kindly give an amateur easy directions how to draw microscopical objects, and which is the best or cheapest instrument to use?*

A neutral tint camera lucida is the cheapest camera. Focus the object, attach the camera to the eye-piece, turn the microscope tube to a horizontal position; place the drawing paper, beneath the camera, on the table; adjust the illumination on paper
ect until both are distinct when the eye is in position,
the camera. Practice drawing until you become
iera lucida is used to obtain correct outlines only.
e filled in from memory, after repeated ex-
the camera.

ITEMS

Fine Adjustment of the Beck Pathological Microscope.—The fine adjustment of Beck's new pathological microscope is, we believe, one of the most sensitive and delicate fine adjustments yet produced. It is constructed, as shown in the accompanying figure, in this manner: The body of the instrument is supported upon the barrel DD; this barrel is accurately and smoothly fitted to the triangular core EE. At the top of the barrel DD is screwed the cap G to which is attached the rod C. This rod



passes through the centre of the core EE and connects with the lever arm A at B. The action of the spring L, which is wrapped spirally around the rod C, raises the body of the microscope and

holds the lever arm A tightly against the screw-arm F. The slightest motion, therefore, of the screw F is communicated through the lever A and the rod C to the body of the microscope.

The great delicacy of this arrangement will be appreciated when it is noticed that the distance from IH is double the distance IB, therefore any motion at B is only half that at H. This adjustment is one of the most delicate made for use with high powers.

Gum for Slide Labels.—Dissolve 2 grams of aluminum sulphate in 20 of water. Mix the solution with 250 grams of strong mucilage (2 of acacia gum to 5 of water). The aluminum sulphate greatly increases the adherent properties of the gum.

NEW PUBLICATIONS

Life-history of the Vermillion-spotted Newt. By Prof. S. H. Gage. Ithaca, N. Y.

This is a reprint from the *American Naturalist* of December. Prof. Gage is not only a naturalist and a microscopist, but an artist, as appears in the brilliantly-colored frontispiece. A bibliography contains full records of the literature of the subject, while the text would seem to leave little more to be said on the subject.

Die Botanische Mikrotechnik. By Dr. A. Zimmermann. Tübingen, 1892, pp. 278.

This is a handbook of microscopical technique especially as related to botanical work. It is illustrated with 63 engravings in the text and accompanied by a copious bibliography and index. Being in German it is not available to American workers in general, but some of our advanced manipulators who read German will find it useful. The price is 6 marks. Order it from H. Laupp'schen Buchhandlung in Tübingen or from F. A. Brockhaus in Leipzig.

·THE·MICROSCOPE·

AN ILLUSTRATED MONTHLY MAGAZINE.

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Seventeenth Annual Report of the American Postal Microscopical Club, Troy, N. Y., 1892.

By R. H. WARD, M. D.

Our Membership has changed but little during the past year. The few withdrawals which have naturally occurred have been amply balanced, perhaps, by new accessions of very capable members. A few have been dropped for general negligence which made it impossible for any circuit to exist with them in it.

One of the greatest of the partly avoidable troubles of the Club is a breaking up of the circuits and consequent entanglement of the circulation, which adds greatly to the care and labor of management and often subjects the old members to the danger of receiving boxes a second time. This mostly results from members joining thoughtlessly, and then dropping out, without any sense of responsibility, after a short time. As we cannot, and would not, question the right of any member to leave if he desires, there seems to be no way of prevention except either to establish a large entrance fee, which has not been thought best, or else to constantly remind members that candidates should not be invited or recommended to membership without being fully informed as to what the Club is and what it is not, or without a deliberate desire (as well as opportunity, ability, and experience) to be, and work, in and for the Club as it is, and to attend to the boxes and note-books personally—not leaving them to careless or inexperienced students or indifferent office boys who will kill the Club by losing or destroying its only means of existence, and only be sorry when too late to do any good. During the past month the Club has suffered the loss by death of one of its oldest and most

esteemed members, Prof. Albert P. Brown, of Camden, N. J. He has long been distinguished as a chemist as well as a microscopist, and has contributed improvements in mounting media, cements, etc.

Slides.—It was intended, as announced in the last report, to withdraw, early in the season now closing, all the old and well-worn boxes, and to circulate only the recent boxes still in fair condition, and the boxes of the proposed new special series which was then solicited from the membership. Owing to unavoidable delay in regard to the latter series, upon which an immense amount of work has been spent but which is still far from ready, this plan failed of adoption for this season. Next season the new special series and this season's circuit boxes are expected to give us a great improvement on the past. This is stated as a hope and an expectation, however, and not as a promise for the non-fulfilment of which we can be responsible. One or two members have expressed dissatisfaction—to state it mildly—at not enjoying this season such a set of boxes as we last year invited the members to furnish but which they have not yet completed. It will readily occur to any thoughtful person that where one or two persons are, by the necessities of the case, compelled to do nearly all the executive labor of the Club, without compensation or paid assistants, they cannot and do not guarantee the prompt, faithful, and devoted service of a hundred and forty non-resident members, but can only undertake to make useful, so far as circumstances allow, the work those members find opportunity to do.

When the special series of boxes was proposed a year ago, it was feared that it would be a half-year's work to get them ready; but this estimate proved to be not half large enough. Liberal encouragement and assistance was offered by a limited number of members, and a number of exceptionally fine boxes, accompanied by not a little of novel and remarkable note-book work, have already been secured. Some further boxes are promised, that are not yet ready; and considerable progress has been made toward making up boxes in various ways to complete the set, which it is hoped to have in good order before fall.

A new set of the regular circuit boxes will also be needed; and collecting boxes for the same will be sent through the circuits as soon as they can be got ready, omitting, so far as possible, those members that have contributed special boxes this season Members will oblige by having their slides ready, and the descriptions and discussions ready to copy in the note-books, before the boxes arrive, in order that the boxes may be forwarded with as little as possible; since it is very important that they all be filled rned to headquarters before July 1st. By sending to rs the original MS. of the notes, after copying it into ks, much trouble and delay will be avoided. Members

are once more reminded that commonplace commercial objects are of no use to the Club, that only those slides are worth contributing that have some special ideas connected with them, some history or relation worth recording or peculiarities worth discussing. By selecting such slides, however homely, and writing them up in good shape, much improvement would be made, especially if the secretaries or other experts would advise, supervise, and if necessary assist, to secure circuit boxes and note-books with a character like the best specials.

Slides and note-books, like most things, wear out with age and use; and by the time they have finished one circuit they are, mostly, only fit to throw away. If we withdrew them as soon as they looked unpresentable, the best thing would not be seen by a quarter of the members. We are therefore obliged to make the most of them that can be done, trusting to members to keep them as neat as possible, make such repairs as may be necessary, and treat them with care and respect so long as they are capable of showing the points for which they were made.

The slides circulated during the year have presented the usual and inevitable gradations from the best that experts can make to the "comparatively worthless" work of beginners who have less to give and more to receive in the Club and who are therefore less "blessed" than those in a position and with a will to contribute to their encouragement and advancement. Some of the boxes have been so good that of one a very leader among American microscopists wrote "Box * * * is intensely interesting;" while of another a distinguished professor remarked, "If the Club could produce specimens like these it would not be necessary to purchase any from abroad as examples." Others have been too commonplace to use; while the great majority, naturally, have been of intermediate grade, showing some things to imitate and some to avoid. On mature and liberal thought it is probably best that this should be so. If the Club consisted wholly of experts it would have a narrow, if not selfish, character, and if the learners were left alone they would make poor progress; only by combination and by mutual co-operation can the pleasure of giving and the profit of receiving be adequately attained.

Our slides are constantly illustrating the proverb, "Many men of many minds," since, if having any character at all, they are pretty sure to find some one to interest. To a comment, "An indistinct, poorly stained specimen," written by a most competent judge, another no less experienced and able adds, "For one, I disagree with * * * If he can equal or excel it, a contribution of a few slides might prove very instructive to some of the Club, myself for one." An expression of disappointment by an expert called out this reply from a professional in another department: "It might prove of invaluable benefit to the Club if the learned

professor would generously circulate a set of such better sections (if any) with simple explanations of just what they are intended to demonstrate. In the meantime these slides and notes enable the beginner (and one must have a beginning) to make out for himself points of structure which have heretofore puzzled his untrained powers of discrimination." To a somewhat flippant remark, "These slides are not things of beauty or a joy," some one replied tartly, "Hypercriticism is one form of ignorant conceit. A truly educated eye will not perceive thickness or dirt to the exclusion of merit in a mount. The first question ought to be, Does it show what the preparer intended? If it does, study it, and do better if you can. There are too many merely thin sections that give no idea of the relation of structures. These mounts are quite good enough for me." A professional slide by a well-known expert brought out the following interesting and suggestive discussion:

"Such a slide proves absolutely valueless to 90 per cent. of those who see it." * * *

"Well, count me among the other 10 per cent. The micro-organisms are stained with aniline blue, and the other elements with Bismark brown. The slide demonstrates the wonderful selective properties of the dyes." * * *

"It would always be well to examine a slide before condemning it. Any one by using a suitable power can see the rod-shaped bacteria stained dark blue or red among the irregular granular particles stained brown." * * *

"Would be glad to see a few more such slides. With proper objectives one can notice the excellent staining." * * *

"The adverse critics of this slide have doubtless merely followed the common practice of condemning because they did not understand." * * *

"I, for one, will have to be counted among the 90 per cent.; for not having the advantage of being a physician, I am in want of some 'illumination' on this slide, and the only knowledge I have of it has been left out of it by the contributor for others to mention. I think that rule 'a' is to be observed just as much as any of the others, even if it is not printed in italics or red ink." * * *

"All of the above comments are well founded. The slide is interesting and instructive, but the contributor ought, in justice to his fellow members, and particularly to those who are not posted in that line, to have given an explanation to point the learner to the information which the specimen conveys. Those who have hastily condemned the slide (and its contributor?) for the lack of such explanation had better first have tried to have 'posted up' on the subject so as to be able to understand and appreciate it, and would then have withheld such comments, which must have been made without much effort to understand the slide." * * *

Another object, this time of the 'popular' sort and of quite secondary value to anybody, instigates the following compliment and the succeeding very sensible review of the principle involved:

"An instructive slide and much better for Club circulation than many of those of histology which are not fully understood by the general run of microscope users." * * *

"The above growl demonstrates the difficulty of pleasing everybody; also how easy it is for somebody to be very selfish and narrow-minded. I am a student of histology, but I delight in the variety of the objects circulated through our Club. I examine every one. My microscopical horizon is thereby broadened. I become better educated, and in all manner of ways a better student of histology. I can examine with pleasure and profit a well-prepared object of any class, and feel it to be a pleasurable duty to add my mite to the notes whenever possible. I notice our friend does not give one word of information on the 'instructive' fly's leg, which might help a member more ignorant, if possible, than himself. Friend, come up higher, study every mount with attention, try to see what others can see in it, and you will soon notice 'something' interesting even in a histological mount; and then, and not until then, will you be able to appreciate a 'fly's leg,' and see in it what you have never yet seen. 'Fireflies' are not truly flies, but beetles; and the portion of the insect shown in the mount is the tarsus, answering very nearly to the ankle." * * *

Note-Books.—While it seems still difficult for members to realize the importance of giving an adequate dissertation upon their slides when contributed to the Club boxes, some improvement has been made in that direction. The want of fuller descriptions is thus expressed: "This is a very interesting botanical specimen, and certainly deserves a better description than the owner has seen fit to give, probably from lack of appreciation of the subject. If each contributor would study his own contribution and write a short, concise description of the same, it would do more to enlighten the members and maintain the interest in the Club than anything else. However well the contributors understand the subject, it is not to be supposed all members are as familiar with it. To me the contributions from members are much more interesting than many that come from abroad."

Much has been done by those expert in various departments, in the way of adding illustrative photographs and helpful notes to the various slides that pass. This work is fully appreciated: "Some of these notes are very benficial." "All honor to * * * who so kindly gives his time and knowledge to help those of us who are not versed in the histological points of these slides." While it would be impossible to specify all these generous contributors, and equally difficult to draw a line of excellence anywhere between them, there is one, Dr. S. G. Shanks, of Albany, who

has done so much of this work, adding careful notes with elaborate drawings to numerous other boxes as freely as to his own, that simple justice requires a special acknowledgment. On the other hand, it is sometimes the misfortune of the Club to lose some of its most capable members, because they do not find the notes, in quantity and quality, up to the standard of their own ideas. It is doubtless correct, on purely selfish business principles, for one who knows nearly all that is known in any department to resign and leave because he cannot learn as much from others as they can from him, but it is not so obviously in accordance with scientific interests; and the management, at least, does not yet understand how the books can be kept supplied with instructive notes if those members who can write them think necessary to withdraw because they are not already written by those who cannot.

The use of bad ink, careless penmanship, and illegible pencil marks are causes of annoyance and of just complaint. "I feel inclined to criticise some of the inks used by contributors, that seem nearly worthless. Numerous good inks can be got."

In cutting up book pages, printed on both sides, for insertion in the note-books, as with the Cole boxes and some of the latest specials, it is obviously impossible to make each extract begin and end exactly as it ought, since the subdivisions of the subjects seldom correspond exactly with the limits of the pages. In such cases, of course, the pages are divided in the most practical way, giving each slide the portion most essential to it.

The extracts from the note-books, printed herewith, include the available notes not heretofore published. A much larger number of equally valuable notes, of the text-book order, are not suitable for separate reading.

In the early years of the Club we were accustomed to send around the books when "finished" (worn out?) for the inspection of the original contributors. But the satisfaction gained was so little, and the complications and difficulties so great, that the business was neither satisfactory nor successful. It was therefore suspended, and the plan adopted of sending only the really important notes to the persons directly interested. Lately, however, the suggestive notes have been so fully published as to leave little need of such formality.

Circulation.—During the season of 1890–'91 most of the circuits received 18 or 19 boxes, the extremes being 16 and 20. During the present season the circuits have, thus far, received from 12 to 18 boxes, and they will probably receive from 1 to 2 or 3 more, making a total average of 15 or 16. Of course these numbers, except the totals, only apply correctly to the first names in the circuits; as the boxes already credited to the circuits will continue to pass the later members for some weeks to come.

essary irregularity in the movement and intervals of the

boxes has been, as usual, in some cases aggravated into a positive nuisance by the gross neglect of two or three members; and the same has occasioned the loss of several boxes, either permanently or for a whole season. It is often necessary to drop otherwise valuable members because they neglect and break the rules so badly that no circuit can live with them in it; but unfortunately we cannot know it until the harm has been actually done, nor can we know which of the rules to emphasize by printing in letters of fire, because we can't know by the breaking of which one, next, another circuit or two will be wrecked. It may be absurd to hope that people will do right, unless they should all be born again; but every member who receives anything wrong, however trivial, should have it corrected at once. If a box be received insufficiently stamped, or badly enclosed or directed, or with stamp or address on the wrapper, or with slides of other boxes mixed, or with the tin box-cover gone, or with a slide with label missing or containing improper writing, or with more or less slides than according to the note-book, or anyway wrong (we can't reprint the whole rules!), write to the sender and have it corrected at once. It is wrong to forward anything that isn't right, and useless to record in the note-book that "this slide ought to be traced and found," instead of finding it.

Finances.—The treasurer's books, which have been examined and approved by the managers, show the following balances for the Club year ending August 1, 1891:

RECEIPTS.		DISBURSEMENTS.	
Balance on hand	$14 32	Postage and stationery....	$76 60
Entrance fees and dues....	172 50	Supplies.....	27 50
		Printing.....	62 05
		Balance	20 67
	$186 82		$186 82

The Fifteenth Annual Meeting of the American Microscopical Society.*

By ROBERT W. SMILEY,
WASHINGTON, D. C.

The American Microscopical Society, formerly the American Society of Microscopists, held its fifteenth annual convention in the city of Rochester, N. Y., August 9 to 12, inclusive. The meetings were opened to the public and enough popular interest was manifested to insure a goodly attendance.

The opening meeting was held in Anderson Hall, on the University campus.

*Abstracted from the *American Monthly Microscopical Journal* for September, 1892.

The morning and afternoon sessions of the society were given up to business and reading of papers, while the evenings were devoted to the reading of the presidential address and various social gatherings.

The Delta Upsilon chapter house, at the corner of University avenue and Goodman street, was the headquarters of the society, and with two exceptions its meetings were held at Anderson Hall. The first exception was Wednesday evening, when the president delivered an address at Music Hall, and the second the grand microscopical soiree at the Arsenal Thursday evening.

Tuesday Morning.

Prof. Lattimore, of Rochester, welcomed the visiting society in a most cordial address. He referred to the visit the society had made to Rochester in 1884, and then said: "The university says to your association what the Spaniard tells his guest—'This house is yours!' We wish to thank your society for the influence which it exerts on our city."

President M. D. Ewell, of Chicago, responded to this friendly greeting with thanks, and expressed the wish that there might be a full discussion of all papers.

The following were then elected members of the society: A. W. Montfort, Burlington, Iowa; E. E. Glover, Terre Haute, Indiana; Professor E. R. Boyer, Chicago; Henry Leffman, Philadelphia; Dr. E. K. Dunham, New York; H. F. Sedgwick, Nashville; E. M. Mitting, Chicago; C. H. Gordon, Cook county, Ill.; E. L. Sherwood, Houston, Miss.; E. S. Mattison, Pottes county, Pa.; O. C. Fox, Washington; George Rust, Denver; C. S. Bower, Philadelphia; G. W. James, Chicago; Alfred Lasche, Chicago; Dr. W. E. Everette, Tacoma, Wash.; W. N. Preston, Chicago; C. O. Smith, Portland, Me.; Miss L. S. Brown, Angelina, N. Y.; J. E. Bull, New York; B. W. Griffith, Los Angeles; Clark Bell, New York

President Ewell, of the committee on the World's Fair, reported that the Fair people wanted to hold a microscopical convention or congress in May, but as a large number of the members of the society were teachers he did not think such a date would be a good one. The society referred the matter to the executive committee.

Secretary Seaman started an interesting discussion on the matter of a standard microscopic screw. Upon this question Mr. Edward Bausch spoke of the recent discussion of the matter in Germany, and the difficulties in the way of the adoption of a standard. "The broad gauge screw," said he, "is undoubtedly a thing of the past. The tendency of manufacturers, which, of course, reflects the tendency of popular opinion, is to reduce lengths and size. With the smaller instruments now manufactured it is safe to say there will be no enlargement of the screw."

Four sections of a new constitution were adopted, and the remainder of the session was occupied with similar routine business. As many of the most prominent members of the society were expected to arrive in the afternoon, it was resolved to adjourn until evening.

An invitation was received from the Bausch & Lomb Optical Company to take electric cars, to be provided for the visitors, and inspect the company's works. The matter was referred to the local committee.

Tuesday Evening.

The evening session was devoted to the reading of the presidential address. In spite of the extreme heat and the technical nature of the subject there was a fair attendance at Music Hall. The subject was "The Relation of the Microscope to the Administration of Justice."

Wednesday Morning.

The first paper of the day was then read by Prof. Gage, on "Methods of Decalcification in which the Structural Elements are Preserved." Prof. Gage gave a practical illustration of this method, using part of the rib of a cat.

Dr. W. C. Krauss read a paper on the diagnosis of tumors.

New members were elected as follows: Adolph Lomb, Rochester; S. A. Ellis, Rochester; Dr. T. Eugene Oertel, Washington; E. F. Bigelow, Portland, Conn.; Charles U. Amelie, Rochester, Minn.; Professor Bentley, Chicago, Ill.

The remainder of the session was occupied by a discussion of plans for a working session at the meeting at the World's Fair next summer.

Wednesday Afternoon.

The society met at 2 o'clock in Sibley Hall and listened to a very interesting lecture by Rev. D. W. Smith on "Recent Results in Photomicrography by Improved Substage Illumination." The lecture was illustrated with work done by the author.

Dr. George M. Sternberg, U. S. A., gave a very entertaining discourse on "Photomicrographs by gas-light," illustrated with lantern views.

At 4 o'clock the microscopists enjoyed an excursion to Lake Ontario. Supper was taken at the Hotel Ontario and speech-making was the order of the day.

Thursday Morning.

Professor William A. Rogers, of Colby University, Waterville, Me., read a paper on "The Filar Micrometer." Professor Rogers stated that in his work of investigating standards of length he required a Filar micrometer of superior construction. Failing to

find such an instrument in the market, he asked Bausch & Lomb, the well-known optical firm, to make one which would fulfil the required conditions. After many trials the instrument was completed to his entire satisfaction. The instrument in question is an eye-piece in which there is a fine spider web moved by means of a precision screw. The difficulty in ordinary micrometers consists in the lack of delicacy of movement of the springs which press the micrometer plate against the end of the screw. This difficulty Bausch & Lomb have averted.

Professor Rogers read a second paper, on the "Use of the Microscope in the Workshop." The speaker stated that he had for some years advocated a more extensive use of the microscope in the ordinary operations of mechanical construction. His paper was an enumeration of the different mechanical operations in which he found the use of the microscope profitable.

Thursday Afternoon.

Papers were presented at to-day's meeting by Professor Kellicott, Dr. Munn, G. W. Rafter, Dr. Mercer, M. L. Holbrook, Professor E. H. Griffith, and Mr. Frank Zentmayer.

Later in the afternoon the members and friends took cars at the university for the Bausch & Lomb Optical Company's factory, where the remainder of the afternoon was utilized in an inspection of the works.

Thursday Evening—The Soiree.

As at all previous meetings, the soiree was the notable feature of the assembly of microscopists. At 8 o'clock the microscopes were all in place and the exhibit was in full progress.

Most of the objects exhibited were of a popular nature rather than of the most particular scientific interest. Among them were exquisite histological specimens, diatoms, metals, disease growths, tissues, forms of vegetable and animal life, bacteria, trichinæ, gold, hairs, teeth, crystal, &c.

The exhibit lasted two hours, and the wonders of the microscope seemed veritable miracles to some, who for the first time peered through the tube. There were at least a hundred microscopes, and every one of them was besieged by a line of eagerly curious men and women.

In one of the microscopes shown by Professor Griffith was a bouquet of flowers. It was made of the scales of the butterfly arranged with the most wonderful artistic skill in a space no bigger than a pinhead. Another microscope revealed the Lord's prayer through a pinhole. The exhibit which attracted the largest share of attention and which, perhaps, was the most in-

[illegible] a series of nine microscopic objectives interspersed [illegible] owing the growth of the starfish at all stages.

This exhibit was prepared by Professor Charles Wright Dodge and it was besieged all the evening by throngs of spectators. You had to "get in line" and gradually work your way along.

Another exhibition which attracted much attention was the circulation of blood in the tail of a fish, shown by William Drescher. This was accomplished in a most ingenious way. A living gold fish was securely fastened in a small vessel containing just enough water to keep it alive. Its tail was projected over the side of the vessel, pressed between two small pieces of glass and firmly fixed under the microscope. The power of the microscope was so high that it resolved the blood, seen through the transparent covering of the fish's tail, into countless little corpuscles, which gave it the appearance of multitudinous grains of sand following each other in and out and round about in endless procession up one aisle and down another, constantly twisting and turning. An extra gold fish lay in a pail of water by the side of the microscope so that the fish on duty might be relieved should he give signs of failing vitality. Mr. Drescher stated that a fish would ordinarily accommodate the investigator in this way for an hour or an hour and half. At the other end of the room was exhibited a frog's foot in similar fashion.

Many other equally interesting specimens were on exhibit, but space will not permit a more extended notice. The soiree was a great success.

Friday Morning.

The microscopists held their concluding session this morning. Professors Kellicott, Rogers, and Claypole were appointed a committee to consider the question of changing the time of meeting so that it should hereafter more closely precedethat of the American Association for the Advancement of Science. Mr. C. C. Mellor, of Pittsburg, read the treasurer's report, showing expenses $866.58 and a cash balance of $178.17. The society accepted with thanks the anonymous offer of these prizes, to be awarded at the next meeting: For the best original investigation of plant life, first prize $50, second $25; for the best original investigation of animal life, first prize $50, second $25; for the best mounted slides, first prize $20, second $10; for the best photomicrographs, first prize $20, second $10. Professors Kellicott, Gage, and Seaman are to announce the conditions in the next number of the society's official publication, and the executive committee of the society is to make the awards.

Professor E. W. Claypole chose a popular subject and spoke with great emphasis on the general introduction of cheap microscopes. The paper pointed out the importance for the diffusion of a knowledge of microscopic science of a low-priced grade of compound microscope suitable for students of high schools and

college graduates. They can seldom afford the cost of even the cheaper instruments in the market, and consequently drop in most cases their studies in this direction on leaving school or college. Most of the machinery and some of the adjustments might be dispensed with and the cost thus reduced. It is not likely that by any means the cost of such an instrument could be brought down to the level of the school microscopes, which have been in use in England for nearly forty years, but considerable reduction could be made by the changes suggested. Good instruments of the nature above outlined are sold and have been sold for about $15 in England, and are abundantly sufficient for the needs of the average microscopical student. Moreover the ownership of a microscope is essential for the continuation of the study, and the purchase of even an inferior instrument often leads to the purchase of a better one in later life. This reform may be expected to swell the number of that part of the community from which the ranks of the microscopical society are recruited.

By way of illustrating his remarks, Professor Claypole exhibited a microscope which had been sold in England forty years ago for $15. He wished that something could be done here to put a cheap microscope within the reach of students. This brought forth considerable discussion. One wanted to know what were the wages of the men employed to make that instrument. Another called it a toy for a child, a third thought it a pretty poor piece of work. Professor Rogers and Dr. Ewell spoke in favor of a cheap microscope of American make for class-room work, urging that a poor microscope in the hands of a student after leaving college was better than no microscope at all.

The nominating committee reported the following officers and the report was adopted by their election: President, General Jacob D. Cox, Cincinnati; First Vice-President, Dr. George M. Sternberg, Brooklyn; Second Vice-President, Dr. A. Clifford Mercer, Syracuse; Secretary for three years, Dr. W. H. Seaman, Washington; Treasurer for three years, Charles C. Mellor, Pittsburg; Executive Committee, Dr. Lester Curtis, Chicago; Dr. J. M. Lamb, Washington; Dr. William C. Krauss, Buffalo.

The convention adjourned to meet in Chicago next summer, but most of the microscopists remained over in Rochester to attend the meetings of the Association for the Advancement of Science.

Fine exhibits of microscopes, objectives, accessories, microtomes, mounting instruments and materials, lenses of all descriptions, cabinets for slides, microscopical literature, and mounted objects were made by many well-known dealers in microscopic supplies.

The following papers were presented to the committee, but several, owing to the heat and absence of authors, were read by titles only.

By Prof. D. S. Kellicott: "A Crustaceous Parasite of the 'Miller's-Thumb.'"

By Dr. R. G. Nunn, "Scavengers of the blood."

By Mr. G. W. Rafter, "Microscopical Examination of Potable Water."

By Dr. A. Clifford Mercer, "Photomicrographs and Photomicrographical Apparatus."

By Prof. M. D. Ewell, "The Concave Mirror," "The Microscopic Identification of Ink—A Metrical Examination of 1,000 Signatures of the Same Person."

By Dr. M. L. Holbrook, "Structure of Red Blood Corpuscles in Man."

By Mr. Clark Bell, "Blood and Blood Stains."

By Dr. Thos. D. Briscoe, "The Wenham Binocular—can it be made adjustable to a variable tube length?"

By W. N. Preston, "On a New Mounting Table, and a Practical Drying Oven?"

By James H. Logan, "Precious Stones as Microscopic Objectives."

The society met in Rochester eight years ago, and though its growth has been very large since then, a large proportion of the delegates seem to have pleasant recollections of their former visit.

The meeting was an unqualified success and it is to be hoped that the sixteenth annual meeting, which is to be held at Chicago in August, 1893, will prove to be an attraction for a still larger number of the devotees of the science of microscopy.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

67. *How is a polariscope used, and where may I find a good description?*

A polariscope consists of two similarly prepared prisms of Iceland spar. One of them is placed closely beneath the object, and is called the polarizer; the other one, called the analyzer,

must be placed above the objective, anywhere in the optical axis. One of the prisms must be arranged to revolve, and for convenience the polarizer is so mounted. At certain relative angular positions of the prisms the polarized light will display colors in a suitable transparent object. Good practical directions for the use of the polariscope may be found in The Microscope and Histology, part 1, by S. H. Gage, printed by Andrus & Church, Ithaca, N. Y. A good description of the apparatus may be found in Practical Microscopy, by Geo. E. Davis, published by Lippincott Co., Philadelphia, Pa.

68. *How shall I prepare the leaf of lettuce, to show the laticiform tubes?*

Make a long section of the midrib; boil in a weak potash solution until tender; tease out the vessels; float them on a slip, and examine in glycerine. They will not be permanent, but may last several months.

69. *How shall I mount cross sections of stems of apple, pear, currant, etc., as opaque objects?—Amateur.*

Dry the stems; bore a hole in a block of wood, pack in the stem snugly; use a sharp smoothing plane to shave off the top of the block including the stems; pick out the sections and mount them dry in a shallow cell formed by a ring of varnish. Keep the sections dry.

70. *Why does mica show prismatic colors like Newton's rings?—Polariscope.*

Mica is composed of thin plates or leaves, easily separable by splitting or bending. Loosened or partly separated plates will show the colored rings, produced by diffraction of light.

71. *Dana says water is a mineral. If so, is it proper to say "mineral water"?—E. C. Hoyt.*

Mineral water is a technical or trade term applied to a natural water containing soluble mineral substances in appreciable quantities, in contradistinction to a good drinking water, which should not contain more than 10 grains of solids to the gallon.

72. *Is there life in all water? Is there more life in a drop of rain-water than in artesian well water?—E. C. Hoyt.*

Bacteria and other fungi will be found in all water coming in contact with our atmosphere. Rain-water collected during the latter part of a protracted storm will be nearly devoid of life. Artesian well water, being in contact with the earth, will contain more germs than rain-water.

73. *How are insect eggs preserved?—Student.*

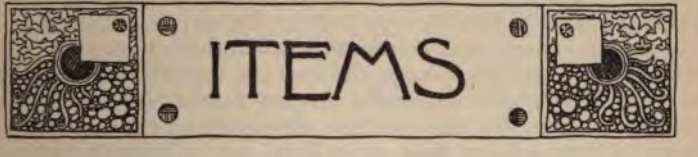
They are best mounted dry and viewed with a surface illumination.

74. *Where can the eggs of the house fly be obtained?—Binocular.*

The house fly lays its eggs in August, in stable manure, and they hatch in 24 hours. When found dip the eggs in boiling water to kill them; dry and mount them as opaque objects, or drop them into carbolic acid and mount them in balsam, to study the embryos.

75. *Does the Abbe condenser give as good a dark field illumination as Wenham's paraboloid, or a polarizer?—C. A. B.*

The Abbe condenser is a high-grade illuminator, and used with thin or minute objects. Wenham's paraboloid is best for use with ordinary objects. The polariscope prism is not an *ill*uminator in the above sense.



Sectionizing Hydra Viridis.—About five years ago I tried the experiment of growing the hydra from sections. I cut a large and vigorous specimen into about ten pieces, and placed them in a small test-tube with water drawn from the household tap; in two or three weeks, eight out of the ten pieces had developed in full-grown vigorous hydræ. Of course I was careful to exclude all such things as cypris and cyclops, and everything that seemed likely to prey upon the undeveloped sections, and also allowed plenty of water, so that there was no risk of the oxygen becoming exhausted, a rather important feature where animal life is concerned, either in development or prolongation.—*F. J. George, in Science-Gossip for August, 1892.*

The microscopic determination of rock-forming minerals.—A book, in Russian, by F. Loewinson-Lessing, bearing this title has been published in St. Petersburg. It contains tables of the rock-forming minerals based on the writings of Rosenbusch, Michel Lévy, and Lacroix as well as of Doelter and Hussak. If you know the characters of the mineral, the book enables you to determine its name. One table is based on examination with polarized light. Others depend on external morphological characters, the crystalline systems and other optical characters. About 80 of the most practically important minerals are included and all others are excluded.

NEW PVBLICATIONS

Outlines of Entomology. By Mary E. Murtfeldt. 8vo, pp. 135 Published by the author, Kirkwood, Mo.

This work was originally prepared at the request of the State Board of Agriculture of Missouri and embodied in its proceedings, but the author has had copies bound and offers them for sale at fifty cents each. It is a delightful book and one that is simple, easily understood and therefore attractive. It has been prepared by a writer learned in her specialty and one who has justly earned an enviable reputation. Primarily prepared for the use of farmers and horticulturists to teach them to recognize their friends and enemies among the insects, it contains much that is of interest to every intelligent person fond of the out-of-doors world. The author has written the book remembering, as she says, "that there are those who have yet to learn the difference between a beetle and a bug, or between a moth and a butterfly; to whom the transformations of insects offer a puzzle which they cannot solve, and who are completely daunted and discouraged by a half dozen successive technical terms." Miss Murtfeldt has prepared a little treatise which can be cordially commended to any one having the least interest in the subject.

Catalogue of Photographic Lenses. The Bausch & Lomb Optical Co., Rochester and New York city.

Like this firm's catalogue of microscopes and objectives, this list is a work of art, a beautiful specimen of what an intelligent printer can do with the types when he tries and when he has the help of the paper-maker. The contents, too, will charm the photographer, for the catalogue describes not only the best of the firm's own lenses, with those of Clark, the celebrated manufacturer of telescopes, but it introduces an entirely new series, the Zeiss anastigmat lenses, made from the new Jena glass after formulæ worked out by Prof. Abbe, with whose work all microscopists are familiar. These new photographic productions, for Bausch and Lomb hold the patent for this country, seem able qualities.

THE MICROSCOPE
AN ILLUSTRATED MONTHLY MAGAZINE.

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Glycerine Mounting.*

C. E. McCLUNG, PH. G.,
COLUMBUS, KANS.

The use of glycerine as a mounting medium is not as universal as its qualities merit it should be. The convenience with which a balsam mount is made proves a temptation which many microscopists cannot resist, and as a result, numerous mounts are entirely spoiled by consigning the object to a medium not adapted for its reception. There is a fitness in all things, and the saying is as applicable to microscopy as to other departments of work. Balsam has its use and glycerine its application, and the two should be confined to their respective provinces. Frei says: "What balsam is to dry tissues, glycerine is to moist ones," and the saying might be made even more emphatic.

Glycerine has the advantage of being non-volatile, colorless, slightly affected by changes of temperature and of having a high refractive index. An advantage of special importance is, that it remains perfectly colorless for any length of time, while balsam, in a few years at most, becomes yellow and finally so opaque that the preparation is worthless. The soft, natural appearance which objects mounted in glycerine have renders any extra labor incurred in their preparation a matter of little moment to the artistic manipulator.

The difficulty experienced in the manipulation of glycerine deters many from its more frequent employment. If attention is paid to details, however, it will be found but little more difficult to use than balsamic mediums. In order to bring out the points of importance, a brief description of the preparation of an ideal

* From a paper read at the meeting of the K. P. A., June, 1892.

mount will be expedient. Attention is first directed to the material and apparatus used.

The glycerine should be pure and free from dust and *air bubbles*. To keep it free from these contaminations, devices such as are recommended by Carpenter and Prof. James are excellent. These are bottles, containing the glycerine, and provided with glass tubes, whereby the glycerine is forced out by air-pressure.

The cements may be of a balsamic nature, but preferably zinc oxide or asphalt. Any cement not affected by the medium may be employed, but experience has proven that the two above named are the best.

The other essential parts of the completed mount are the slip and cover-glass. No special mention is required concerning these except that they should be *perfectly clean*. To insure this, the practice of leaving them until ready for use in a bath of ordinary battery fluid is recommended.

In preparing a mount the operations naturally divide themselves into four divisions, coming under the heads, 1. Preparing the cell; 2. Preparing the section; 3. Placing section in the cell, and 4. Securing the cover-glass to the cell.

Under the first head attention is called to three points, viz., thickness of the cement, depth of cell, and age of the cell.

Upon the consistency of the cement depends in a great measure the formation of a good cell. It should not be thin enough to spread, yet should flow readily and smoothly from the brush. The depth of the cell should be such that a complete support shall be provided for the cover-glass without causing it to bear upon the object when cemented down, and yet should not be of such a depth as to interpose an unnecessary stratum of glycerine between the section and cover-glass.

Of more importance, perhaps, than any other point, is the direction regarding the age of the cell. It is a common practice to ring a cell and use it while fresh, the manipulator arguing that a more perfect union of cell-wall and cover-glass is secured in this manner. *Perhaps* this is true: but it is at the expense of the slide's usefulness. An author already quoted is authority for the statement that an ordinary balsam cell will, in drying, shrink 30%.

Under these conditions and in view of the fact that glycerine is non-compressible, something must give way when the cell contracts; and this is either the cover-glass or cell-wall. Whichever it is, the final result is the destruction of the mount and loss of all the work involved in its prepar..ion. This leads us, then, to make the following statement: *Never use a "green" cell.* The older ...l the better and, at ordinary temperatures, two weeks is the ...pace of time in which a cell of medium depth will ...soned.

Assuming the mount to be a section of vegetable tissue, the steps involved in its preparation would be the cutting, staining, washing, and dehydrating. The length of this article will not permit any reference to cutting, so the process of staining is next noticed. Any stain insoluble in the glycerine may be used. It is best applied immediately after the cutting of the section. After the section has acquired the proper depth of color, it should be thoroughly washed and then placed in glycerine. From here it goes through the next process—placing in the cell.

In placing the section care should be exercised to have it exactly in the centre of the cell. With the section thus situated a drop of glycerine is allowed to fall upon it from the dropping-bottle. Take the clean cover-glass between the left thumb and forefinger and place the left side in contact with the drop of glycerine; draw it over until supported on the left edge of the cell-wall; loose the hold of the left hand and allow the cover-glass to fall gradually by supporting the right edge with a needle. Having thus placed the cover-glass and centered it, place a clip upon it. The superfluous glycerine thus forced out is washed away by means of a jet of water from the wash bottle so directed as not to strike under the cover-glass. Some water *does* get under, but this does no harm, as it supplies moisture which the glycerine otherwise would have by "creeping" from the cell.

When *thoroughly* dried by means of strips of bibulous paper the slide is ready for the last step—securing the union of cover-glass and cell-wall.

This result is best obtained by ringing once around the cover-glass and allowing this coat to dry before applying cement enough to hide the junction of the cover-glass and cell-wall. When this latter step is accomplished the mount is essentially complete, but no one who has a pride in his work will leave the slide unstriped. There is no more beautiful slide than one formed of white cement and ringed with black. Properly labeled and cleaned, the slide is ready for the cabinet; and if the due amount of care has been exercised in its preparation it will always be a source of pride and pleasure to its owner.

Mode of Keeping Fresh-Water Animals Alive.—Dr. J. Dewitz recommends the spreading of a piece of canvas or small dampened towel over the bottom and side of a plate on which the fresh-water animals are placed. They must then be covered with another wet towel and put in a cold room. The towels must be washed and wrung out every fourth day, and any dead specimens removed.—*Jour. Royal Micr. Soc., London, June, 1892.*

The Ultimate Structure of Striated Muscle.*

By. J. H. WYTHE,

OAKLAND, CAL.

The errors of interpretation are not uncommon in any branch of science, and need to be specially guarded against in histology, since many structures are not only complex in their living state but are liable to change after death. While *post-mortem* appearances may indicate living diversities, they may also indicate physical and chemical alterations. The various reagents used to differentiate structure may also produce appearances very different from the living state, while the most perfect objectives will only allow one to see accurately that part of the object which lies in the optical plane. These sources of difficulty, in addition to diffraction lines and ghostly images produced by imperfect illumination, render the task of investigating minute structure by no means easy, yet care in the preparation and observation of structure, and comparison with the recorded views of others, will surely lead one in the right direction.

The structure of striated muscle fibre has been a vexed question since the beginning of microscopic investigation, although many text-books, so called, flippantly describe it and many other imperfectly known structures as matters of positive knowledge. Such descriptions hinder the progress of true science. On the other hand, it is necessary to avoid the opposite sentiment of impracticability. Doctor Dallinger, the able editor of the last edition of "Carpenter on the Microscope," declares that "it is well in the present state of knowledge to refrain from conclusions as to the absolute structure of the striated fibrillæ. It ranges itself, from the modern microscopist's point of view, with other striated objects, and will require the possession of lenses of a numerical aperture twice or thrice those which are now within our reach." Such an assertion from so eminent a source is extremely unfortunate. Its tendency can only be to discourage and abridge microscopical pursuits. If this spirit had prevailed in former times few discoveries in histology would have been reported.

Soon after the microscope was applied to the investigation of tissues it was found that the fasciculi, or fleshy bundles of voluntary muscle, were separable into fibres, which were divisible into minuter fibres, or fibrillæ. Under some circumstances, such as treatment with dilute hydrochloric acid, the fibres showed a tendency to divide into discs. With a magnifying power of 250 diameters, or more, the fibres also showed alternate light and dark spaces, the origin of which has given rise to much discussion. [illegible], Virchow, and others describe the fibre as consisting [illegible]nules, lying side by side, and the fibrillæ or discs

*he San Francisco Microscopical Society, July 6, 1892.

to result from the manner in which the granules may be separated, either longitudinally or transversely. A number of granules detached lengthwise form a fibril, while transverse division forms discs. The opinions of other eminent histologists regarding muscular structure were given, when the doctor came to speak of his own observations and conclusions. While he had confirmed the opinions and observations of others on this subject, he had found, particularly in crab muscle treated with alcohol, a still more distinctly duplex structure. By teasing with fine needles the fibres are seen to be largely made up of longitudinal fibrils, each of which forms a chain of muscle prisms or elongated sarcous elements, linked together by narrow grooves. Stretching with the needles in many cases makes the grooves to disappear and the fibril to assume the form of a cylindrical rod, often tapering at the end. In addition to these longitudinal fibrils, teasing with the needles demonstrates the intervening substance to be also fibrillæ, but generally smaller in diameter, and arranged in spiral form around the others. The intermediate fibrils pass between the longitudinal ones, and after twisting around them so as to form a groove in each rod, they bend upward again to the next groove, and so on to the end of the fibril. Contiguous grooves in the longitudinal fibrils produce the discoid marks or divisions.

In teasing, the needle sometimes breaks off one of the slender fibrils at the place where it binds the sarcous filaments, or just beyond it, when it appears as a broken thread. At other times the needle separates the filaments from all its grooves, showing the spiral weaving, or it may appear as crossing from fibril to fibril, in a ladder-like form. In the study of these spiral weavings the doctor found it necessary to bear in mind that the fibrils are all semi-solid and glutinous, and liable to vary in appearance, according to the tension, or from variations in the original structure.

I have not found it practicable to demonstrate the spiral plaiting in every piece of muscular fibre examined. In some specimens the glutinous muscle substance had been so hardened by the reagent that teasing with needles could not unravel nor even separate the fibrils. In such instances the fibres showed the striæ in the usual way; but softer and more flexible fibres are readily separated into fibrils which, when stretched with the needles, are more or less unraveled.

A small piece of teased fibre may be stained and mounted in glycerine. The end portions of the specimen will probably exhibit unmarked longitudinal fibrils. Sometimes these show the grooved markings, producing a prismatic or bead-like structure. Where the needles have not been used, the transverse markings and short fibrils, like Bowman's sarcous elements, will be seen;

but where the fibre has been torn, the spiral weaving will be manifest. It requires a greater stretch of the imagination to conceive such results to be the effect of the alcohol or of the teasing. The original structure of the muscle's substance can only be responsible for the microscopic appearance.

A Bacteriological Potato-Section Cutter.

By CHARLES F. DAWSON, M. D.,
WASHINGTON, D. C.

Several methods of preparing potatoes for a culture medium are now in vogue, each having more or less efficiency, and a variable amount of labor.

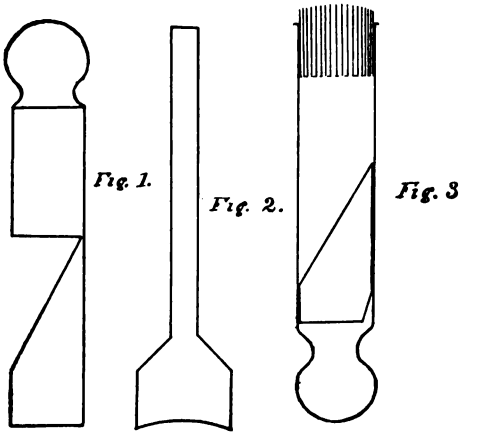


Fig. 1. *Fig. 2.* *Fig. 3*

One of the most common methods is the use of a large cork-borer, or apple-corer, to cut a cylinder from the potato. This cylinder of potato is divided diagonally, thus making two preparations. Pieces of glass tubing are inserted into the thick ends of the two pieces of potato, and they are placed into ordinary test-tubes and sterilized. The pieces of glass tubing serve to support the potatoes above the level of the condensation water, which always settles into the bottom of the tube. In some instances, specially made culture tubes having a constriction near the bot- a of the tube are used. The constriction supports the potato, ondensation water falls into the reservoir thus formed in f the culture-tube.

medium is to be kept for some time, we find that hange in the form of the potato, due to evapora-

tion of water from it. The inoculation surface becomes irregularly concave, the thin end becomes dry, and curls, and the preparation presents an unsightly appearance.

When the potato cultures are to be used for exhibition purposes, it is desirable to have them present a neat appearance. The aim of the writer is to describe an apparatus which he has devised to prevent the changes in form referred to.

The apparatus consists of two pieces: a plugger, represented by figure 1, and a curved knife, represented by figure 2.

The plugger is made from a metal tube about six inches long, and of a diameter a little less than the culture-tubes to be used. The side of the metal tube is cut out by sawing slantingly through the wall and across the inner diameter of the tube to the opposite wall at such an angle that the distance traversed by the saw will be about two inches, and then by sawing vertically across the diameter of the tube to the wall of the opposite side. The end of the tube nearest the side opening is sharpened from the outer surface, and a wooden handle is fitted into the other end.

The curved knife (fig. 2) is used to cut a convex surface on the potato section so as to compensate for the loss by shrinkage from evaporation. After a time this convex surface will become nearly flat, whereas, if the surface were cut flat at the outset, it would now be irregularly concave.

This knife is made by cutting out a segment of a circular tube of about one and one-half inches in diameter, the segment having continuous with it a narrow portion of the wall of the same tube, which portion serves as a handle. The segmental portion is sharpened upon its convex surface.

When it is desired to make a potato preparation, both ends of a large potato are cut off, and the plugger is passed through it by a rotary vertical movement. The potato cylinder, which appears in the plugger, should be long enough to reach a short distance into the hollow handle, so that it will be held firmly. By passing the curved knife into the potato cylinder and across its diameter in contact with the sides of the opening in the plugger, the cylinder is divided. The outer piece of the divided cylinder will fall out, and the piece which remains in the plugger now has a beveled surface for inoculation, and it can be removed by pushing it up a short distance into the hollow handle of the plugger.

The thin end of the section should be trimmed off for the distance of about half an inch to prevent its curling, and a notch should be made in the side of the end of the cylindrical portion of the section to admit the passage of moisture from the water reservoir of the culture-tube to the potato chamber above it.

Figure 3 represents the potato section placed in a reservoir-tube ready for use.—From the *American Monthly Microscopical Journal* for October, 1892.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

76. *How should the microscope and MS. be managed in an examination to detect a forgery ?—Opaque.*

Employ a low power; sometimes a hand lens will be sufficient. Known genuine writing should be examined for peculiarities in the flow of the lines and loops, hesitations at certain letters or parts of words, etc. An imitation will show more hesitancy and less firmness of line than the natural, habitual, mechanical run of the genuine script. Much patient study may be required to form an opinion in a given case.

77. *Can the fats of other animals be detected by the microscope like the fats in oleomargarine ?—E. C. Hoyt.*

There has been no particular incentive to study fats, other than lard and beef, but the soft or oily fats probably differ from the lard or tallow fats as lard has been found to differ from beef tallow.

78. *Is an animal hair a hollow tube ?—Paraboloid.*

A hair is not really a hollow tube but has a cellular pith, which may contain air, probably as a result of drying.

79. *How are silk, flax, and cotton distinguished ?—C. A. B.*

These fibres are very easily obtained for study and should be mounted and examined by every one who has a microscope.

Silk is a solid glass-like fibre, has no markings. Flax is a solid fibre with numerous transverse markings, and usually a central or longitudinal mark. Cotton is a smooth, flat, twisted fibre, really a flattened tube with prominent edges; no markings except those due to folds or twists; air entangled in the fibre may simulate a pith.

80. *Is the wax found in the human ear a fungus, as has been claimed ?—Histology.*

The wax or cerumen of the external canal of the ear is a natural excretion produced by certain glands; it is acrid and offensive to insects and deters them from voluntarily entering; this is supposed to be one of the functions of cerumen. Fungi in this canal of disease.

81. *Are the so-called flesh-worms in the skin really worms? —Medic.*

No. They are simply plugs of the normal sebaceous matter, the external end blackened with dirt. When pressed out they closely resemble a small black-head worm, but a careful examination will reveal their true character.

82. *Is the itch a disease or a multiplicity of parasites? Is the barber's itch the same?—Scratcher.*

Itch, or scabies, is caused by a minute eight-legged insect which burrows under the outer skin and lays its eggs as it goes along. The irritation of this proceeding causes the itching. The eggs or young of this parasite are spread about by violent scratching and they may be easily transferred to another person by contact.

Barber's itch is a fungus affecting the hair just below the surface of the skin.

83. *Are the companion colors ever found in the same species of plant? Why does the green wheat turn yellow and the green forest leaf turn red.—H. E. E.*

It has been said that no one species of plant exhibits all the primary colors in its flowers. This is probably the rule, but there are exceptions. The Flowering Pea, Stock, and Linum show all the primary colors. The Dahlia, Portulacca, Chrysanthemum, and others show two primaries and a secondary, the latter color usually a purple. Cultivation may be largely responsible for this variety.

84. *I have read that gold may be reduced to so thin a film that light seen through it appears green. Does this color appear when it is seen with the microscope?—Optician.*

Very thin films of gold transmit a greenish light, but are yellow by reflected light. If the film be heated on a glass plate transmitted light will appear ruby red; if burnished down the green tint reappears. These facts are accepted as a proof that gold is semi-transparent. There is no record of a microscopical examination of these extremely thin films.

85. *What, if any, is the difference between a sunfish (aurelia) and a jellyfish? See The Microscope, vol. xi, pge. 222.*

An aurelia is a medusa, or jelly-like radiate animal. It is not a fish, and should not be called a sunfish. The true marine sunfish is a tropical species, weighing several hundred pounds, and is a true fish, frequently found basking in the sun, showing a portion of its body above the surface of the water.

86. *Can you tell me anything about a parasite found on the foot of the tiger? A Scientist, in the Medical Brief, says it is a counterpart of a tiger in every respect.—S. H. Cowden.*

The "scientist" who gave currency to that yarn is either a humorist or a Chinese laundryman. No such a parasite exists.

87. *How may cane-sugar be detected in honey?—Amateur.*

Cane-sugar may be detected with a saccharometer, or by diluting with water and carefully crystallizing, the large cane-sugar crystals may be obtained.

88. *What does right-hand or left-hand polarization mean? —Polariscope.*

The prisms of a polarizer being crossed to produce extinction of light, certain substances introduced between them have the power to partially restore light; if the analyzer be turned a certain number of degrees, light will again disappear; this is called the angle of rotation, and may be right-handed or the opposite. Different specimens of quartz, although of similar chemical composition, may require right or left rotation, because of some internal peculiarity of structure. The different sugars exhibit the same peculiarity. A polarizing instrument called a saccharometer employs this principle to detect the different forms of sugar which could scarcely be separated by chemical processes.

89. *Color depends upon the velocity of light. Revolving a polarizer changes colors to their complementaries. If so, are all minerals uniform in their behavior toward light?—E. C. Hoyt.*

The behavior of minerals depends upon their thickness, internal structure, and the direction of their axes of crystallization. Polarized light is not precisely similar to ordinary light; it is something less than ordinary light, and must be studied as a thing of its own kind. A plate of mineral of varying thickness produces tints which follow the law of Newton's rings, but must be much thicker for use with polarized light than with ordinary light.

90. *What is the purpose of those crystals in the onion skin? —Botany.*

The crystals are usually oxalate of lime and crystallize from an excess in the sap. They are an excretion.

91. *What is the best work on Petrology, and why are not more of them written?—Minerals.*

Petrology is still a young study. Such works are expensive and have a limited sale. See Am. Mon. Mic. Journal, vol ix, pge. 70, a good paper with references to publications in German.

92. *Is there any dictionary or enclyclopedia which gives a full correct definition of the word "sand"?—H. E. C.*

H. E. C., or rather E. C. H., has written a pleasing little paper on "Sand," to be found in the Am. Mon. Mic. Journal, vol. xi, pge. 68, and still seeks a definition for a very diversified product of geological activity. A mineral is distinguished by a more or less definite chemical composition. A rock is a mass composed of one or more minerals. Sand is pulverized rock from one or more localities, distributed, modified, mingled and mixed by frost and flood. Recent foraminifera, polycistina, and spicules are no more a part of sand than are snail-shells or fish scales.

93. *Is there any reason why the binocular microscope should not be preferred to the monocular, expense and size excepted? —Purchaser.*

The binocular has a limited use and with low powers only. If one is to be purchased see that the prism is arranged to be entirely removed, so the upright main tube may be wholly clear and allow the use of wide-angle objectives, as a monocular microscope.

94. *Name three good books on the microscope for a beginner. —Beginner.*

The following are good, cheap, and well-illustrated books suitable for a beginner:

Stokes. Microscopy for Beginners. A work devoted to pond life.

Phin. How to use the Microscope. Gives good descriptions of the microscope and accessory apparatus, with directions for mounting simple objects.

M. C. Cooke. 1,000 Objects for the Microscope. A sort of a small dictionary of microscopic objects.

WAYS AND MEANS

Photomicrography of the Solar Spectrum and Absorption Spectra.—D. Joaquin Ma. de Castellarnau describes in *Cronica Scientifica, Barcelona*, August, 1889, 7 pp. (sep. copy), the method which he employs to obtain photomicrograms of the solar spectrum. In the disposition of the microscope and spectral eye-piece which he adopts a ray of sunlight is directed by a Prazmowski heliostat upon a mirror, by which it is reflected

along the axis of the microscope, placed in the horizontal position; the Abbe condenser projects an image of the sun upon the plane of the stage; the objective and field lens of the eye-piece form a second image in the plane of the diaphragm, and lastly the front lens of the eye-piece produces a third image on the ground-glass of the camera. Between the front lens and camera is interposed a direct-vision spectroscope. The eye-piece employed was a special projection one of Zeiss, which consisted of two lenses giving a system perfectly aplanatic and achromatic. For taking absorption spectra the transparent solid or liquid under examination is placed on the stage of the microscope.

NEWS · FROM · THE · WORKERS ·

The Protozoa—a Phylum of the Animal Kingdom Considered Biologically.

Prof. Henry L. Osborn, of Hamline, Minn., has described the PROTOZOA in the *American Monthly Microscopical Journal* for October. Among other things, Mr. Osborn says:

It would seem very remarkable, indeed, if we were not now used to the conception that there are so few different kinds of elementary substances and so few different elementary principles. The early mind looked on all observed differences as radical and indicative of fundamental and essential unlikeness in things observed. This quality of mind persists to-day in rudimentary peoples and in the untaught and unobservant of more advanced races. But the person who lives in the light of the present era of scientific thought expects that the complex will upon inspection resolve itself into the simpler and finally into the simple. If we examine any single member of the higher groups of animals or plants, we find that, complex though they may be, their actions are the algebraic total of the powers of the multitudes of cells which compose them. Cell growth and reproduction, tissue work, division of labor, comprehend activities in plants or animals which in the total we speak of or think of as the creature's life.

Side by side with this idea of the biology of an animal or plant as the sum of the activities of component similar cells or really prior to it at the outset, though of slower growth, is the complementary conception which sees groups of animals or plants as the

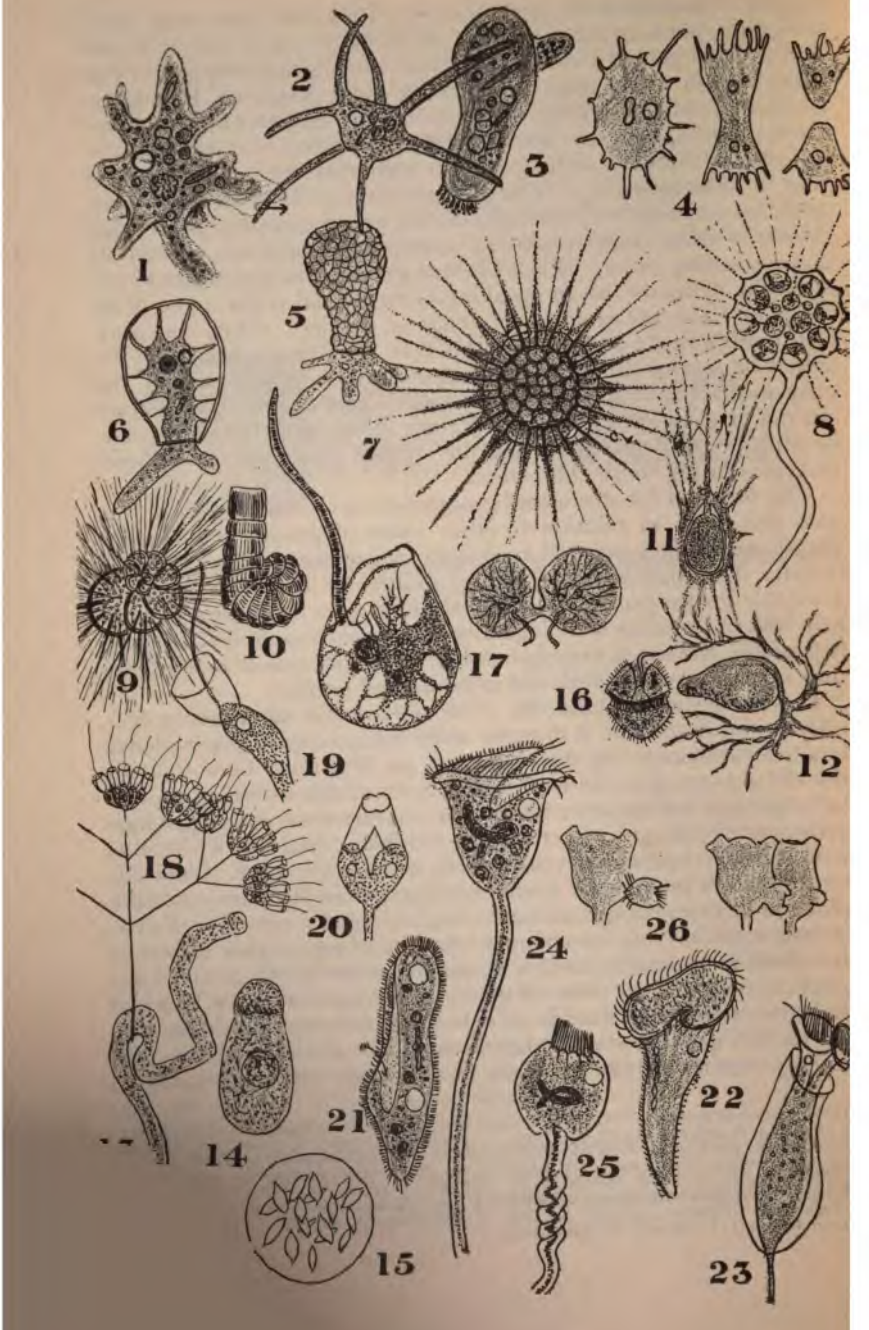
natural descendants of prior forms. This idea has long been struggling for existence in the world of beliefs, and cannot yet be said to have gained a permanent place among the concepts of the laity, though it is fully accepted by most professed biologists. Looked at collectively the different kinds of animals appear to be serial; that is, they are not isolated and unlike, but are more or less closely similar. The grades of similarity are somewhat parallel in different series. The groups that have been formed by the study of animals includes phyla the most comprehensive and classes, orders, families, genera, species, and varieties, named in their lessening order. Each of these groups has a name and very often the name we use in speaking of an animal is the name of its order or class, not of its exact genus or species. Thus we speak of the moth or fly or bee. In this way the same animal may be called by several different appellations, and we may speak of the gray squirrel as such or as a sciuroid, rodent, mammal, vertebrate animal or even living thing. We are thinking of different peculiarities in each case as we use the various names of the squirrel as representing those characters.

The fact that the correlated groups are serial among themselves and also stand in relation to other series of groups is an easily demonstrated fact and will appear at once as we examine the protozoa. The present article will be an attempt in the limited space available for the purpose to set forth the classes and orders of phylum and to examine it biologically for the purpose of discovering, if possible, the serial arrangement of its members and an explanation of the serial arrangement in biological terms.

It is a question whether the Protozoa are still undergoing evolution, and in answer it must be said that no conclusive evidence has been adduced. In the absence of proof it must be noted that the older a group is the less liable its members would appear to be to change, for the same reason that conservatism is always characteristic of old age, viz., the law of habit. And yet while this would argue against the probability of change most, if not all, biologists are inclined to admit that changes in structure can take place at any time and become the beginning of a new line of evolution, whether they be changes born in a body which all admit are likely to be transmitted, or acquired variations which all biologists do not consider transmissible. The cultivation of bacteria and the alteration of their powers is a field of investigation bordering on this ground, and the latest researches seem to indicate that among bacteria at least there are few fixed specific boundaries.

EXPLANATION OF PLATE.

FIG. 1. Amœba proteus; 2. A. radiosa; 3. A. villosa; 4. A. polypodia in act of division; 5. Difflugia pyriformis; 6. Hyalosphenia cuneat; 7. Actinospherium eichornii; 8. Clathrulina elegans; 9. Rotalia sp.; 10. Spirolina sp.; 11. Gromia oviformis; 12. Lieberkuhnia; 13. Gregarina gigantea; 14. Gregarina flattarum; 15. Monocystis agilis, spore formation; 16. Peridinium uberrimum; 17. Noctiluca miliaris; 18, 19, 20. Codosiga umbellata, colony, single cell and cell division; 21. Paramecium aurelia; 22. Stentor; 23. Pyxicola affinis; 24, 25, 26. Vorticella sp. expanded and retracted, and series showing absorption of conjugate.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Amphipleura pellucida.—Mr. C. E. Barr, of Albion, Mich., writes:

"I was much astonished at the letter written you some time ago by 'Amateur,' regarding his resolution of Amphipleura *pellucida*. I am very sure that the key to the problem is that the diatom was A. Lindheimerri. I know that Dr. A. Y. Moore, a short time before his death, mounted a number of slides of this species in the bromo-sulphide of arsenic compound, which is undoubtedly the one your correspondent refers to.

"Dr. Moore gave me one of the slides himself, and it is easily within the reach of a good objective of 1150 or 1200 (dry) aperture."

Cole's Series.—In answer to a query in the April *Microscope* the following has been received:

"I note the repeated inquiries in the *Microscope* regarding the 'Cole Series.' I procured a set a few years ago from W. P. Collins, 157 Great Portland St., London, England.

L. M. DeLamater.

NEW PUBLICATIONS

Living Matter: Its Cycle of Growth and Decline in Animal Organisms. By C. A. Stephens. 16mo., pp. 107. Norway Lake: The Laboratory Co.

This little volume is, as the author says, a résumé of an extended investigation into the causes of old age and organic death, especially of the human being. The subject is treated as a phil-

osophical study, the author beginning with the consideration of universal matter, which he says feels; "hence the universe has everywhere a low degree of sensory perception.... The earth lives in a certain sense; not the self-conscious life of an animate organism, yet sentient in a low degree." Protoplasm, or biogen, as the author prefers to call it, accepting the word invented by Dr. Coues, is treated after the manner of the chemist and psychologist rather than of the naturalist and microscopist, and after a somewhat extended consideration of the anatomical changes which accompany old age, he concludes that life is never qualitatively but only quantitatively diminished; that death comes not from a decline of initial vital power, but from extrinsic obstacles which befall from material surroundings and from imperfect modes of living. "Death comes not from a law of Nature, for the law of Nature is life. Universal matter lives from eternity and never dies." "A tissue is old because there is little biogen in it, not so much because the biogen has grown intrinsically weak." The human being inclines toward death, according to Mr. Stephens, from three principal causes: by reason of minute mechanical and chemical accidents within the tissues; by physical accidents from surrounding matter, imperfect food and imperfect assimilation; and by the reaction from these as shown in discouragement and world-weariness. "Every one of these causes of death and old ageing is of the nature of an ordinary physical cause fairly within human power to avoid or remedy, and many of which in fact we are every day avoiding and remedying. It is the sum total of these causes which has heretofore rendered death a seemingly inevitable sequence to life. Yet not one of them but can be singly warded off by human science and foresight, and if one, why not all?"

To the scientist death seems as natural as life, and he seeks no reasons for avoiding it. He endeavors to learn what life is, not how it may be indefinitely prolonged, for he recognizes that from the solar system down to a naked drop of living protoplasm, a decline and death are visible from the beginning. Universal death is the law of Nature, not universal life, and the cause can be no more "warded off by human science and foresight" than human science and foresight can ward off the attraction of gravitation or the precession of the equinoxes.

Lessons in the Diagnosis and Treatment of Eye Diseases. By Casey A. Wood, M. D. Sq. 16mo, pp. 154. Detroit: Geo. S. Davis. Price, 25 cents.

This is intended for the use of the busy practitioner that is not a specialist, and it fairly well accomplishes its object.

·THE·MICROSCOPE·

AN ILLUSTRATED MONTHLY MAGAZINE.

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DIATOMOLOGY.

BY K. M. CUNNINGHAM,

MOBILE, ALA.

All science may be said to be both evolutionary and progressive, partaking somewhat of the nature of organized beings; passing from the simple relation to the complex in structure onwards without limit. This corollary is preliminary to an exposition of its application to the science of the study of the Diatomaceæ. As far as the writer's experience has gone, one branch of science, classed under botany and pursued almost exclusively with the use of the microscope, has not had its aggregate field of work crystallized under the distinctive title of a science, but has mostly been designated by some subordinate term. My object is to show, or point out, the justice of grouping together all the allied and auxiliary researches and methods of study of the Diatomaceæ under the title of "diatomology," which in its broader definition would mean to comprise all that appertains to the study of diatoms in whatever manner undertaken. Therefore, accumulated experience suggests that the Diatomaceæ can become the basis of one of the most impressive, instructive, and engaging branches of pure science that may occupy the attention of the human mind.

Firstly, on account of its power in gratifying the purely natural impulse inherent in the mind to be impressed with whatever is beautiful in nature.

Secondly, from its being a legitimate line of research, independent of the merely beautiful, practical, or pecuniary, as science in general takes equal cognizance of the ugly, horrid, or

beautiful; but many minds of a scientific turn refuse to become interested in things not beautiful; this is why the devotion to the study of the diatom never surfeits or becomes irksome; hence, with some show of truth, we might paraphrase a popular saying, "Once a diatomist, always a diatomist."

Thirdly, the study of the Diatomaceæ from merely an observational point of view, whether in relation to their place in nature, what role their creation was intended to fill in the economy of nature or of earth-building, and their biological functions in life, is capable of drawing forth the highest and best efforts of mental genius, erudition, and the power of the judicial and critical qualities in bright minds, in dealing with the numerous problems suggested by repeated and lengthy association with their investigation. A field of human effort is here offered well worthy of capable minds, whose deductions may be grand enough to stand as a trinity with the genius that points out the position of invisible perturbing planets in space, or those whose decisions go on record as the final and unalterable disposition of questions as between right and wrong.

The latter two fields of genius appear to be the conceded attributes of many minds, the outcome of the total evolution of all past advances made in erudition and civilization. Why, then, should there not be a third character of talent, equal to the former two, to deal with the co-ordinate problems of geology, palæontology, and biology? These latter three sciences are invariably invaded or trended upon by the diatomist, even though he may have but the fame of an amateur. The above outline brings us to the scope of action of the diatomist. His field of operations is catered to by and is coextensive with the entire physical globe, and in its atmosphere, as well as in its ocean depths, the rocky strata composing its crust, penetrated for thousands of feet, is within his horizon. When one looks back retrospectively on the colossal and lengthy labors of Ehrenberg, condensed in his "Mikrogeologie" (1856), utilizing therein nearly every possible means within the reach of man to bring to light what he could, those who now live can look with deep admiration on this genius of the past, who proved thus early the comprehensiveness of this branch of science; but the later and more recent activity in this line of research has enormously increased our knowledge of the occurrence and distribution of the Diatomaceæ in the liquid and solid component elements of the earth. To appreciate the available resources within reach of the diatomist it is only necessary to peruse the trade catalogues of two of the leading European commercial *preparateurs*. In these we have a tabulation, both by mineral family groups and by their geographical distribution, showing varieties of material derived from localities nearly as widely separated as from North pole to South pole, from tropical America to tropical

Africa ; but these lists suggest little of their geological association. We have them from summits and slopes of mountains thousands of feet in height ; from the oceans thousands of fathoms in depth ; from bituminous strata, marly strata, peat strata ; from intra and post glacial strata ; from subplutonic strata ; from lignite strata ; from American Miocene clay strata, penetrated for a thousand feet in depth ; from drifted specimens from Pacific Ocean bottom stranded on its west coast ; from vast stratified areas in Mississippi and Alabama ; from the rocky strata of the islands of the Atlantic and Pacific Oceans ; from vast beds of extinct lacustrine areas ; from subpeat areas ; from the muds and humus of swamps, marshes, creeks, bayous, rivers, bays, and seas, and from the ooze of ocean depths ; from saline and thermal springs, and from the aquatic flora of all waters ; again, inclosed in altered and petrified strata ; from strata in New Zealand altered and metamorphosed by intrusive igneous action or by volcanic action ; from the guano islands of the South Pacific Ocean, and inland pelagic desert plateaus of Chili and Peru ; from the extinct lake deposits of the Southern river drift or Diluvium period, and the Tertiary sedimentary rocks of the Mexican Gulf coast of the United States ; with recurring announcements of the finding of new deposits ; thus continually furnishing material for unceasing interest in their study. But, perhaps, diatomology will never complete its ideal cycle until, in addition to the listing and naming of new species and noting localities of occurrence, the geological relations of the deposits as to period, association, and sequence of strata, as well as a comparative study of deposit contents, shall be worked out by the larger methods of the geologist as applied to all other rock formations, aided by graphic and pictorial illustrations of the strata and characteristic natural scenery *in situ*, together with a discussion of the attendant phenomena of deposition, with the speculative deductions and inferences to be derived therefrom, the economic relations and value of these deposits to the arts, and all these data digested, correlated, and generalized, shall the full capabilities, impressiveness, and grandeur of this entrancing science be put upon the pedestal destined for it in the arcana of nature.

We have so far but scattered, imperfect, and disconnected gleams of the store of treasures yet to be segregated in the future into one grand whole for the intellectual gratification of posterity's millions. Diatomology comprises within its fold an army of independent investigators whose efforts are largely absorbed in working out and elucidating the many-sidedness of the science : to some the main interest is directed to solving the biological character, or life cycle, to settle definitively its plant or animal nature ; to others to analyze and make clear the delusive and unsettled structural characters of the inert frustule or shell ; to others

the interest is largely commercial, forcing their admiration and enjoyment by the beauty and attractiveness of their artistic arrangement in symmetrical arranged groups and designs and type-plates; others by a desire to complete and possess an exhaustive collection of all known species; others by their incidental and characteristic importance in forming geological strata, past and present; others in the skilful reproduction of them as microphotographic records; others in their nomenclature and classification; others in pressing the discovery of new material or deposits and distribution of same, while many labor with an immediate or remote hope that it may fall to their fortune to establish a new genus or to name and describe a new species; others test their skill in improving or altering the classificatory tables, revising and altering the families, genera, and species, as new lights dawn. Diatomology is in its nature the most catholic and universal science extant, as its pursuit binds together by the sympathetic bonds of reciprocity and community of action every locality on the globe where science is cultivated or the microscope is known and utilized; it converges and focalizes to a central objective point innumerable lines of activity, forever feeding the flame of interest by constantly presenting some new addition in one branch or another, to gratify a laudable curiosity and to convey a gentle and pleasing stimulus to the mind. So let us have a science to be known as "Diatomology." It would be comparatively easy to tabulate a list of names luminous with distinctions and laurels won in pressing the study and perfection of the various subdivisions of this comprehensive field of scientific effort as previously alluded to, but they are, no doubt, familiar to all who may peruse this essay. The comparatively recent publication of Wolle's Diatomaceæ of North America removes the main obstacle heretofore existing to the rapid advancement and expansion of this all-permeating and fascinating study, to this extent at least, as it is within the reach of every one, and furnishes a ready means for the tyro or beginner to launch out at once into the world of diatoms and wing his way through its empyrean.

The writer asks the indulgence of his readers, and justifies the plea made herein, based on long experience in this branch of microscopic science, having had the fortunate experience of putting on record for the initial time the occurrence of one freshwater fossil diatomaceous deposit, two marine fossil deposits, one fluviatile marine deposit, and several deposits of lesser importance, and dissemination of the material, in the fifteenth year of his experience in this science; and having personally handled the leading fossil earths from every well-known locality, and having also examined and consulted all known accessible literature dealing with the Diatomaceæ, as well as having made and put upon record the largest single selected slide of diatoms from

a local circumscribed area, the same studied with a 1-15 homogeneous oil immersion lens of 1.25 N. A. in detail, as well as microphotographed for permanent record, the slide being the largest that has come under my notice, although larger and better slides have been made by others, yet on a dissimilar plan, and of course of greater perfection, merit, artistic skill, and scientific value.

To note additional devotion to the study, I may relate that I have printed with pen and ink, in neat and legible italic letters, the specific names of the 2,300 figures in my copy of Wolle's N. A. Diatomaceæ, contiguous to each species, which makes the book doubly useful, as a glance at any plate dispenses with the use of the numerical tables of species on the opposite pages.

Finally, in treating of this science we must not overlook the marvelous searching analysis of the diatomist, in the study and preparation of material of low percentages, whose successful manipulation aggregates, out of unpromising material, millions of the beautiful frustules whose final function is to entrance the eyes under the lenses of high or low power.—From the *American Monthly Microscopical Journal* for November, 1892.

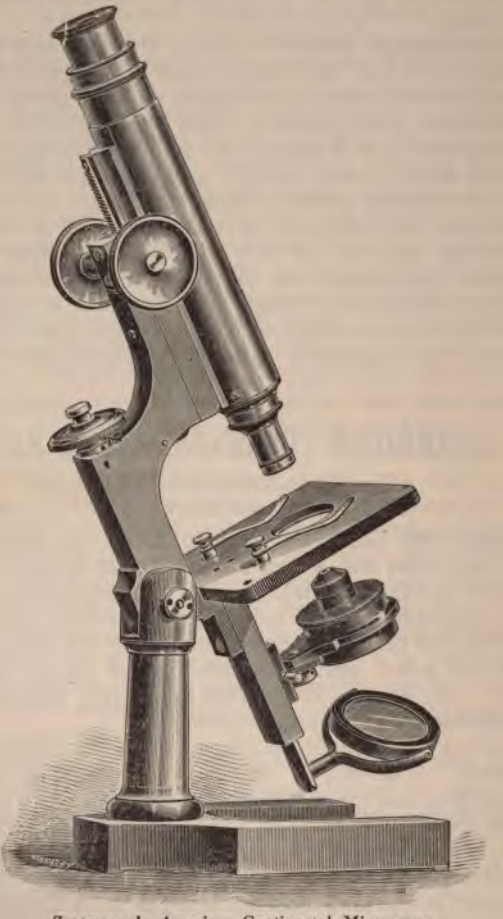
AMERICAN CONTINENTAL STAND.

By FRANK ZENTMAYER,
PHILADELPHIA, PA.

This stand has been designed to meet the wants of those workers who prefer the compact Continental model and yet are conscious of its inherent defects. It is substantially a combination of the upper half of our celebrated American stands with the lower half of the best Continental stands, and is adapted to have added all the usual optical accessories of either class of microscopes. As offered, it answers fully every want of the class-room or laboratory at very moderate cost.

The stand is constructed entirely of brass, handsomely finished and polished. The base is of horseshoe form, filled with lead for extra weight, and gives perfect steadiness in every position. A stout pillar firmly supports the arm of the instrument on a trunnion-joint, which allows all inclinations from the perpendicular to the horizontal position. The coarse and fine adjustments are of the same style and construction as the famous Centennial stand. The arm carrying the body is provided with two slides, the upper and longer one bearing the tube with rack and pinion movement, and sliding in the lower one, which is controlled by a lever of the second order, operated by a milled-headed micrometer screw in convenient position at the back of the instrument. At the bottom of the lower slide there is a shoulder against which the lever acts,

and a spring above presses down against this shoulder, insuring its continuous contact with the lever during adjustments. All the mechanism is concealed within the arm, which is so hollowed as to secure both lightness and greater rigidity. This fine adjustment is free from lateral motion, and exceedingly sensitive. Its con-



Zentmayer's American-Continental Microscope.

struction prevents wear, and is so positive that a revolving nose-piece and attached objectives can be easily carried without injury. It also acts as a safety appliance in case an objective is accidentally racked down against an object, for the spring yields quickly upward pressure. The body-tube is five and one-half inches

long, with draw-tube extending full ten inches, thus giving both English and Continental standards, and accommodating objectives corrected for either length. The stage is made of aluminum, which is incorrodible; the dimensions (three and five-eighths inches square) are commodious even for culture slides or serial sections; the surface is plane, with recessed opening to receive a glass plate, light modifier, or disk-diaphragm, if wanted; removable clips are provided with springs shaped and adjusted to hold a slide, and yet allow easy movement about the field of view. The substage has long sliding movements in the fixed bar beneath the stage, allowing ample room for a condenser or polarizer, and exact adjustments are easily and quickly made by aid of milled knobs extending on each side of the sliding bracket, on which the ring of the substage is centered and affixed instantly by means of a single set-screw with capstan head. The mirrors are plane and concave, of large size, and have complete adjustments on an extensible bar. The diaphragms are cone-shaped, and have three different sizes of apertures. The Abbe illuminating apparatus has a condenser of 1.20 N. A. and Iris diaphragm with complete movements. A condenser of 1.40 N. A. can be substituted, if preferred, for the difference in the cost of the condensing systems. A set of stops are also furnished for dark-ground illumination.

The stand can be furnished with a swinging substage, with or without rack and pinion movement; and with a circular centering and revolving stage, provided with a sliding carriage similar to the Centennial stand; at an additional moderate expenditure, and it is well worthy of such conveniences.

A modification of the swinging substage and mirrors can also be furnished, whereby the extensible mirror-bar slides in another bar which swings from a joint on the under side of the swinging-bar carrying the substage. The construction allows the substage and mirrors to swing independently of each other, click-stops indicating when either or both bars are in the optic axis of the instrument; and permits the substage to be swung aside entirely and the mirrors alone to be then swung into positions for central or oblique illumination, without interference from the substage. The mirrors can be likewise swung aside completely to permit the use of direct illumination, with or without substage apparatus. These movements contribute much to convenient and rapid use, as it is unnecessary to remove and afterward return the substage, or mirrors, or any other part. In this instance the stage is made somewhat narrower to allow the substage to swing clear aside.

New Forms of Bacteria.—Dr. A. Famintzine has found some remarkable new forms of bacteria in the aquarium of the Botanical Laboratory of the Imperial Academy at St. Petersburg.

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

95. *What books give the distinguishing points of marine and fresh-water diatoms, and the forms common to both?—F. W. Taylor.*

Can any reader give the desired information?

96. *Do casts in Bright's disease polarize?*

They do not polarize.

97. *Please explain iron-rust and oxidation.*

Ordinary iron-rust is a chemical compound of 2 parts of iron and 3 parts of oxygen. Consult a chemistry for further information. A clear description of oxidation would fill a page or two.

98. *Would the honey-bee and the bumble-bee produce precisely similar honey from similar flowers?*

Similar flowers produce similar nectar, but authorities differ as to whether the nectar undergoes any alteration in the honey-crop of the bee. The honey-bee, long and carefully bred, with a view to improve quality and quantity, would probably store a better honey from the same flower.

99. *Is the beetle the only insect "at home" in the air, upon land, and in water?*

The beetle is probably the only insect sub-order so represented, but no one species of beetle is equally at home in all those situations. The aquatic beetles fly in the air at night during the breeding season, but they are practically helpless on dry land. They find their food in the water, and the adult beetles must come to the surface for the air they breathe.

100. *Is the Zoöphyte trough not practically convenient for examination of urine?*

The Zoöphyte trough is fragile, not easy to clean, and clumsy for the above purpose. Use a plain slip, a small drop of urinary sediment, and a large cover-glass; if the cover slides about, use a slip of blotting-paper to absorb the excess of fluid. The cover will then remain in place in any position of the microscope stage.

101. *Does the cysticercus ever develop? What disease is caused by it?*

A cysticercus is the larval form of the tape-worm. The eggs of the mature worm eaten by a hog or ox produce measley meat —that is, full of cysticerci; this meat eaten by man produces tape-worm. A cysticercus consists of a tape-worm head attached to a small bladder (cyst) containing fluid (serum). Cysticerci occasionally produce fluid tumors in the brain, kidney, etc., of man.

102. *Why does paper from hornets' nests, when used for wads, keep a gun cleaner than ordinary paper so used?*

Paper from hornets' nests contain sand, mud, or masticated wood, and these substances possess the scouring qualities.

103. *What is the office of plant hairs?*

Plant hairs are outgrowths from the epidermis and assist the latter in protecting the plant from natural enemies.

104. *Can different specimens of tanned leather be distinguished microscopically?*

Attention to hair roots and thickness of epidermis, etc., would probably assist in the identification of the different tanned skins.

105. *Do the spinnerets of spiders vary in number? Are all webs composed of 4 threads?*

The spinnerets are usually 6 in number. The filaments from these fuse together to form a single thread; occasionally a more or less coherent double thread is produced. Some of the spinnerets produce the hard, radiating threads of the web; others add the viscid drops to the circular threads.

106. *Rev. J. G. Wood writes, "An insect never grows larger." Is a house-fly a true insect? What is the technical definition of an insect?*

Insects are full adult size when they emerge from the pupa, the wings only growing and expanding during the first hour. An insect is an invertebrate animal of the sub-kingdom Arthropoda. A typical insect has a distinct head, one pair of antennæ, 3 pairs of legs, respiratory organs consisting of tracheæ, and pass through 4 stages of development, viz: Egg, larva, pupa, and imago.

107. *Is petroleum ever found under granite?*

It is not probable that petroleum, a product of the carboniferous age, would be found normally under a primitive rock like granite.

108. *What is the office of the wart found on the fore legs of the horse?*

Its use is unknown.

109. *Why do plants take double staining? Is there such a thing as triple staining?*

Certain growing or active cells or part of cells absorb stains more readily than older or harder portions. Triple or even quadruple staining is possible. Aniline blue and magenta would stain a growing stem about like this: Pith and hairs, pale magenta; cellular tissue and liber cells, deep magenta; cuticle parenchyma, pale blue; pitted vessels, blue; spiral vessels, cambium, laticiferous vessels and epidermis, deep blue.

110. *Does the fly walk on the ceiling by the aid of suction or exudation and cohesion?*

Flies walk by suction, aided by their claws, on rough surfaces. Many insects with well-developed claws can also walk on a rough ceiling.

111. *About how many genera of diatoms are there?*

There are more than 100 genera of diatoms.

112. *Can the same bee sting twice?*

A bee can sting a soft-bodied insect or larva repeatedly, but the tougher, human skin usually holds the sting by the barbs, so the bee loses its weapon.

113. *What is the explanation of the numerous spider webs appearing at times rather suddenly in the morning?*

These webs are usually the work of recently hatched spiders. Delicate webs may be unnoticed during the day and become plainly visible after dew or dust has settled on them.

114. *Are the facets in the eyes of insects convex or concave?*

These facets are convex and, acting like convex lenses, form a magnified image of near objects.

115. *Which way do the hexagonal cells in the oyster-shell grow?*

Oyster shells grow by successive layers deposited on the inside and extending beyond the edges of the older shell, forming lines of calcified cells parallel with the external surface.

116. *Do several varieties of fungi affecct the same plant, or does each plant have its special fungus?*

Parasitic fungi are either the cause or the accompaniment of disease, and the more highly the plant is cultivated the more delicate it becomes and more susceptible to disease. Plants are usually affected by one variety of fungus, but at times may become the host of several varieties.

117. *Are not sections usually cut too thin? Is not a wedge-shaped section advisable? I use a binocular and argue thick sections.*

A thin section is best for use with high powers, for the study of individual cells and other minute details. A thick section is useful for the study of the relation of cells, vessels, etc., with moderate powers.

Judgment should be exhibited in the cutting; some material should be cut rather thick but in general a thin section is best for real study. A wedge-shaped section might have the thicker portion wrongly placed. A binocular microscope is good enough for pretty views of sand, foraminifera, etc., but not for critical study on sections or anything else.

118. *Do similar moulds grow on allied fruits, like the peach and plum?*

Moulds are lowly plants, and some species seem, at times, to run into others. Their presence depends upon favorable conditions of atmosphere and nutrient surface, but the rule is for each species to find a certain fruit or leaf more favorable for its development, more especially if accident or disease has weakened the vitality of the host plant.

119. *Do varieties of one family of plants produce similar pollens?*

The pollens of one family are similar, but may vary greatly in size.

120. *What is the best method for preparing Herapath crystals for the polariscope?—B.*

Take of acetic acid, 30 drops; alcohol, 10 drops; dilute sulphuric acid, 1 drop; mix. Place a drop of this on a glass slip; add a crystal of quinine sulphate; when dissolved, add a minute drop of tincture of iodine; set aside, protected from the dust; crystals will form slowly. When the crystals are dry, add a drop of balsam, and cover. This process will produce a small nest of small crystals. The preparation of large crystals is a tedious and troublesome process (see Micrographic Dictionary, 4th edition, page 650).

121. *In rearing Dermestes, I noticed parasitic mites on some of them. I have them preserved in alcohol. What is the best method for mounting mites?*

Transfer the mites from alcohol to glycerine and water; after a day or two, mount them in glycerine or Farrant's solution, or transfer them from alcohol to oil of cloves, and thence to a drop of balsam on a slip and cover.

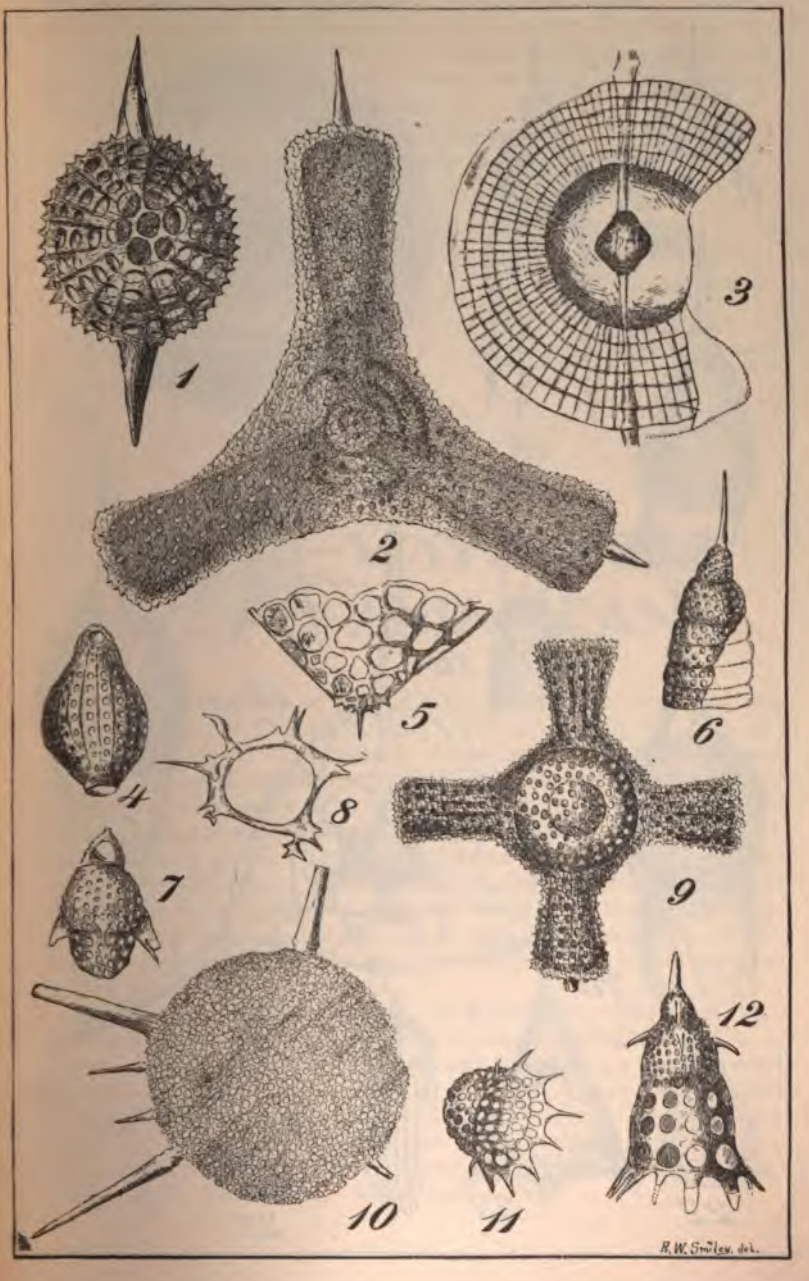
NEWS · FROM · THE · WORKERS ·

Radiolaria: Their Life-History and Their Classification.

Rev. Fred'k B. Carter has described the RADIOLARIA in an extended article which has appeared in the *American Monthly Microscopical Journal* during the year 1892. The article, which was begun in the March issue and ended in the November *Journal*, cannot fail to interest all students of the Radiolaria. Among other things, Mr. Carter says, in the November article:

A word or two more about the preparation and mounting of these forms. I have given the simplest method, but if the student becomes interested he will not be satisfied with that. The forms will not be clean enough to suit him. After trying various methods, at the suggestion of a correspondent I tried that used by Terry in cleaning diatoms, and described in a former number of the JOURNAL, only instead of mixing bi-chromate of potash with the material and then adding sulphuric acid, I use chromic acid, which gives good results and is simpler. Buy the crystals of chromic acid and dissolve in water as you need them. Then take the material which has been partially cleaned by the process I mentioned and put it in an evaporating dish, pouring off as much of the water as possible. Heat the bottle of chromic acid by leting it stand a minute or two in hot water. Heat the material also in the evaporating dish over the spirit lamp. Then add the chromic acid and let it stand a few minutes, keeping up the heat by the spirit lamp. Then pour the material into quite a quantity of water in a high glass and let it settle. Wash until all the yellow color disappears. Then let the material settle in a test-tube, pour off as much of the water as possible and cover with strong ammonia. Then wash several times again. If the forms are not then clean enough repeat the process and keep on repeating till they come out as you wish.

And now, in conclusion, let me say that I am certain there is a vast amount of pleasure in store here for any young microscopist. With many a beginner the question is, what special line to take up. And even many a microscopist of long standing and larger experience is at times at a loss as to what he shall make a subject of close investigation. If any of you are in that state, or ever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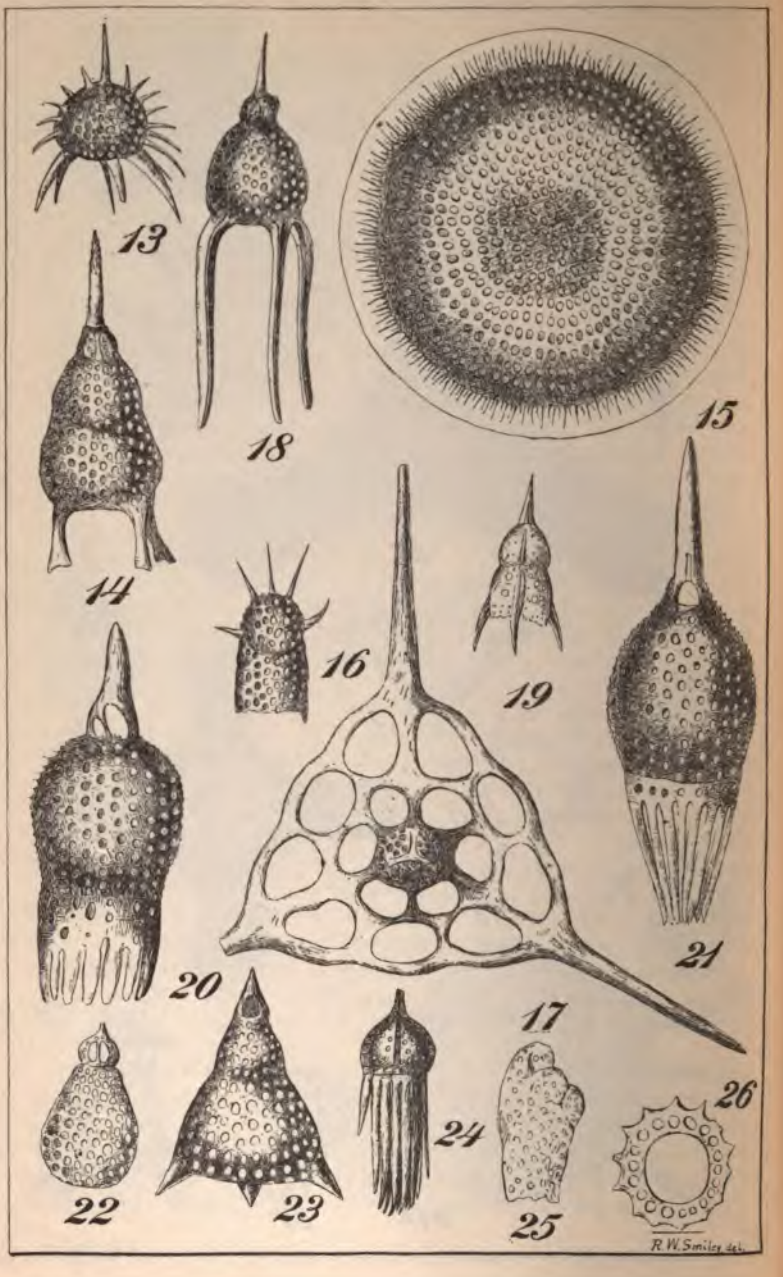
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find yourself in it, casting about for some special line of study, I would advise you by all means to settle on the *Radiolaria*, and work at them thoroughly. First, because they are so easy to prepare, and, secondly, because I know they will amply repay all the labor you may put upon them.

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Fig. 13. Ceratospyris Echinus.
14. Thyrsocyrtis Rhizodon.
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22. Lithopera Lagena.
23. Lithechytris Tripodium.
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26. Stephanolithis (Lithocircus) annularis.

[THE END.]

A Microtome for 50 cents.—Dr. Hinz has described his instrument in the *Omaha Clinic*. The main body is a tin pot 3 inches high by 8 in diameter. A bridge 2 inches wide crosses the top (or open end of the can) and is soldered to the sides of the pot. In its centre is an opening which is the termination of the well, and around the well opening is a glass ring over which the knife is to glide. The space around the well can be filled with ice for freezing. Connected with the well he has a millett screw four inches long and with 40 threads to the inch. One revolution produces a section 1-40th inch thick; one-half revolution, a section 1-80th inch, etc. An amputating knife or razor can be used to cut the sections.

Study of Compound Eyes of Annelids.—Mr. E. A. Andrews macerated the eyes of annelids in Bela Haller's liquid, in potassium bichromate, and in sea-water containing a small amount of sulphuric acid; the last method was found very useful. The staining reagents used were Mayer's acid carmine, Czokor's cochineal, and methyl-green. Sections were stained with Kleinenburg's hæmatoxylin, and Grenacher's fluid was used for depigmentation.—*Journal of Morphology, 1891.*

NEW PUBLICATIONS

The Pharmacology of the Newer Materia Medica. Embracing the Botany, Chemistry, Pharmacy, and Therapeutics of New Remedies; in 15 monthly parts; subscription price $3.00; single parts 25 cents. 8vo. pp. 1307. Detroit: Geo. S. Davis.

The object of this publication is to collect accounts of those new remedies that have been so rapidly introduced within the last few years, and to embody them into one comprehensive whole. The work contains reports of special botanists, results of physiological researches, and descriptions of pharmaceutical preparations. The botanical portion is especially valuable, as the descriptions are full, with, in many cases, illustrations of the plant and its parts, with further illustrations of its microscopical structure. Although the reports of clinical properties are in many instances founded on but one or two observations, and should for this reason be received as still *sub judice*, with only some probability of value, the work contains much information gleaned from the medical and therapeutical journals, and presents it to the practitioner in a condensed and convenient shape.

The treatment of its subjects is usually thorough, as far, at least, as its authorities enable it to be. A good example of this is to be found in its consideration of Coca, which includes synonyms, portion employed, natural order, habitat, properties, active principles, botanical description, history, production, cultivation, Coca at home and abroad, chemical composition, notes on the alkaloids, adulterations and substitutions, with general and clinical reports of therapeutic properties, and a complete literature of Cocana, covering 151 pages. The work has four extensive indexes, and although many of its clinical reports are doubtless too deeply rose-colored, it should not be neglected nor overlooked by those that desire to keep themselves informed as to the recent amazing progress of therapeutics and of the Materia Medica.

THE MICROSCOPE
AN ILLUSTRATED MONTHLY MAGAZINE.

Vol. XII. WASHINGTON, D. C., DECEMBER, 1892. No. 12.

The Water-Flea:—Daphnia.*

By THOS. KNOEBEL, Ph. G.,
EAST ST. LOUIS, ILL.

This little creature, inhabiting both fresh and stagnant water, belongs to the class of Crustacea, subclass Entomostraca, order of Cladocera, and family of Daphniadæ. Its color varies from a pale straw color to a bright red. It would be a difficult matter to find a more fitting and interesting subject for the microscope than this little animal, measuring, when full grown, from 2 to 2½ mm.

It has but one eye, five pairs of legs, two pairs of antennæ; the lower being branched and branchleted, and quite large and powerful, are used as propellers in swimming. The head is lengthened downward, forming a sort of a beak, presenting a rather queer appearance. The body, excepting the head and antennæ, is enclosed in two delicate shells, oval shaped, resembling the two halves of an English walnut, and, magnified about 25 diameters, looks very much like fish-netting.

Sexes are separate, the female being readily recognized by the eggs, which are enclosed within the space between the shell and body of the animal. The eggs are retained until the young are fully developed, when they are allowed to escape from under the covering. Have found from two to eleven young enclosed in their temporary prison; and by daily examination have found specimens where the young were so far advanced as to be able to move quite freely, seemingly making attempts to break away from their little prison; now, by carefully rupturing the cover of the

*Read before the St. Louis Club of Microscopists, July 7, 1892.

mother and allowing the young to escape, found them quite able to paddle for themselves. The young measure 5-10 mm., but do not resemble the parent much until about a week old.

Respiration is carried on by means of brancheæ or gills attached to the feet, and are made to work quite briskly.

Circulation is simple, yet complete; the heart, if so it may be called, measuring about 3-10 mm., is situated in the back of the little creature, a little below the head, and, owing to the transparency of the little being, plainly shows its contractions and expansions. The blood is forced forward to the head, slightly downward, around the eye, then along lower side of the alimentary canal, then completely around extreme end of the canal, coming over the upper surface of the canal along the back, and again entering the heart, ready for the next trip. During this journey the gills supply the blood with oxgen extracted from the atmospheric air, contained in the water in this way sustaining the vitality of the blood.

The alimentary canal is a single tube very nearly straight; digestion and defection seem best while the animal is in motion, and, by its peculiar motion when swimming, the water (and contents) strike its lower surface near the head, in this way creating a constant current directly to the mouth, when it extracts what nourishment it may find from the water as it passes the mouth. Its food seems to be both animal and vegetable matter.

The eye is round, and, in proportion to the size of the animal, quite large, measuring 2-10 mm., being composed of an inky substance, inclined to be gelatinous, undoubtedly taking the place of what, in the human eye, constitutes the vitreous humor and retina, is studded with quite a number of small spherical bodies, measuring 1–20 mm. in diameter, representing perhaps the crystalline lens; the whole is inclosed in a sac or membrane, very transparent. The animal has the power of withdrawing and projecting these little spheres, in this black substance, at will.

These little creatures exist in such vast numbers in some stagnant pools as to change the color of the water, often giving it a sort of reddish hue; and on bright days will often form into bands from two to four inches wide, extending many feet into the pond or pool, all moving at the same time, forming a veritable procession, and remaining in line, too. Strange to say, should a shadow fall on part of this band, that portion darkened by this shadow will disappear, but, upon removing the shadow, will reappear and continue their journey with the remaining portion of the column.

During my investigations I found that these bits of life were also subject to disease, and, by carefully examining one of these sickly specimens, found it nearly covered with parasites of various shapes, some being rod-shaped, others oval, and a third, a vicious

little fellow, resembling very much a miniature turtle, all of which were literally living off of this poor specimen, biting it at pleasure, and seemingly enjoying their feast; but, alas! upon examining these very parasites a few days later, who in turn had grown weaker and less active, I found still smaller parasites biting them, verily reminding me of the quaint old saying:

"Big fleas and little fleas
Have lesser fleas to bite 'em;
The lesser fleas have smaller fleas,
And so 'ad infinitum.'"

Microscopic Low Powers.

By FREDERICK W. GRIFFIN, Ph. D.,
BRISTOL, ENGLAND.

The comparatively few microscopists who work with the lowest powers are doubtless fully aware of the advantages of daylight in their use. Lamplight, however, modified by tinted glasses and plane mirror, gives a glare with transparent objects, which tries the eyes and seriously impairs definition. I find, however, the new "Zeltnow cupro-chromic light-filter," which has proved so valuable with high powers, to be equally useful with the lowest. It gives a pale green field, as reposeful to the eye as daylight itself, while a blaze of light is tempered down to due working pitch. All fine details, as the rings of delicate tracheæ, or the markings of a dotted surface, are shown up with the sharpest definition. Of course, color is mainly obliterated in this monochromatic illumination, the picture being virtually in monotone, like a photograph or engraving. Hence this medium is scarcely suitable where color is a leading feature of the object. The solution should be contained in a flat bottle, with clear, polished, parallel sides, as supplied by Baker, and probably other dealers.

One regrets that the lowest powers (4 in. and under) are so little employed by natural-history observers and amateurs. They afford very useful general views of entire objects, and many striking and beautiful pictures, especially with binocular. This disuse arises from the fact of ordinary microscopes seldom having rackwork sufficiently long to allow of the focusing of very low powers. But a simple adaptation will permit the object to be placed below the stage, so that even a 5-inch objective may be adequately worked on almost any stand. The instrument is likewise kept steadier, more compact, and less liable to injury than when left out to an extreme length. When there is a "substage" a square plate may be provided with a short tube fitting beneath, so as to fix on the top of it. This may have either

springs or a sliding bar. The former holds a mount securely during rotation, should this be desirable (which is, however, seldom the case), but prevents the use of large "growing tanks." If a bar is employed for these, an upper one, or even, on occasion, elastic bands passed over the ends, would be needed to secure mounts if rotated. In using tanks it is almost superfluous to point out that the brass plate must be as much below the optical axis as the whole height of the tank, *plus* width of the sliding bar, or the top of the tank could not be brought into the field of the microscope. A polarizing prism could often be used in the bottom of the substage; but ordinary-sized Nicols, even when brought up close to the slide, cut off so much of the field as to make it ineffective for display.

A 5-inch objective needs a prism of a clear inch aperture to avoid "cutting off," and this is large and costly. The above arrangement is all that can be desired for transparent objects; but if the substage does not rack far down there may not be sufficient space between it and the bottom of the main stage to admit of the convenient illumination by bull's-eye of opaque objects in deep cells. In such case it is better to attach the supplementary stage to a separate sliding-piece in the substage dovetails, or even by projecting pins dropping into holes in some solid part of the stand. The latter plan would be available with simple and only moderate-sized stands.

Finally, I may remark that this same want of accommodation in the ordinary rackwork has led makers to nominally much underestimate their low powers. A 4-inch objective should magnify just four times less than a 1-inch; but I find by numerous careful camera measurements, and assuming a 1-inch by Powell and Lealand as a standard, that a 3-inch objective is really about a $2\frac{3}{4}$-inch, and a 4-inch some $3\frac{1}{3}$ inches. The so-called "4-inch" objective is, by the catalogues, the lowest power made; but Mr. Wray, of Highgate, has recently made, by request, for a friend of mine, a "5-inch" (true $4\frac{1}{2}$-inch) of superb quality for a "triplet" or "single-system" glass. With E ocular it preserves perfect definition, and gives the spirals of tracheæ and similar details with full sharpness and absence of color dispersion. Were there any demand, I have no doubt that makers could produce a true 5-inch objective (which they would probably call "6-inch") of equal merit.—*English Mechanic, Nov. 18, 1892.*

Postal Microscopical Club.—The management of the American Postal Microscopical Club announces that Dr. S. G. Shanks, of Albany, N. Y., has consented to assume the office of secretary of the club, which has unavoidably been vacant for some time past. The Doctor will take charge of the department of slides and their circulation; and all communications pertaining thereto should hereafter be sent directly to him.

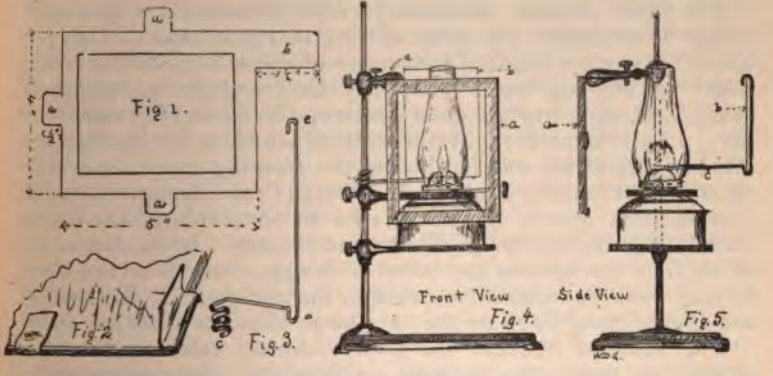
A Cheap Microscope Lamp.

By W. D. GRIER,

BOSTON, MASS.

During the past few years I have seen in the journals directions for making almost everything, from a dissecting microscope to a slide-box, but no one has yet suggested a home-made lamp. Unfortunately "illuminators" are expensive luxuries, and the following description of one which I rigged up in a moment of inspiration may be of use to some whose desires are, like my own, very much larger than their pocket-books. The component parts and their prices are as follows:

A small kerosene lamp with a flat wick	.75
A two-ring retort stand	.65
A "tube clamp," No. 5959 of Eimer & Amend's "Prices Current"	.50
A piece of ground glass, 4x5; ditto of white card-board; ditto of sheet brass, lead or tin, 5x7; 18 inches of 1-16 brass wire	.25
Total	$2.15



EXPLANATION OF PLATE.

a. Frame of ground glass.
b. Card reflector.
c. Wire support for reflector.
d. Clamp.

Cut the sheet metal like fig. 1, place the ground glass on it and bend the ears *a* over to hold it in place; bend the long piece *b* as in fig. 2.

Put the lamp on the large ring of the stand and lower the small ring over it, clamping it firmly at any desired height. Clamp the ground glass in place with its centre in line with the flame, bend the brass wire as in fig. 3, slip the helix *c* over the upright

rod of the stand and place the card in the two little bends at *e*, and the lamp is ready for use. An ordinary side condenser can be substituted for the ground glass, and a cheap tin reflector for the card. I use the lamp in this way for photo-micrography and find it excellent. If a blue glass is desired, thoroughly clean a spoiled 4x5 dry plate or other piece of clear glass the same size, and flow with "King's transparent blue lacquer;" don't apply the lacquer with a brush, as it leaves unsightly ridges. Nearly all retort stands have light bases; therefore remember that when the "centre of gravity falls outside the base" you are very likely to "hear something drop."

By the way, a $\frac{1}{8}$-inch thin glass circle, if coated with the blue lacquer and stuck on the lower end of the cylinder holding the diaphragms (in a continental stand) with a little paraffin, makes a good "moderator" for night work.

The Brine Shrimp of the Great Salt Lake.

By J. E. TALMAGE, Ph. D., F. R. M. S.,
SALT LAKE CITY, UTAH.

The brine shrimp, *Artemia fertilis* (Verril), is a tiny crustacean abounding in the water of the Great Salt Lake. They frequent the surface; indeed I have never taken a specimen from a depth beyond two feet. They may be found in the lake at all seasons, though they are most numerous between May and October. I have taken them in the midst of winter, when the temperature of the water was far below the freezing point; it will be remembered that the concentrated brine of the lake never freezes. The females greatly preponderate; in fact, during the colder months it is almost impossible to find a male. In the latter part of summer the females are laden with eggs, from four to sixteen having been repeatedly counted in the egg pouch. The males are readily recognized by the very large claspers upon the head.

The artemiæ frequent the shores during calm weather, but rain drives them into the lake. Oftentimes they congregate in such numbers as to tint the water over wide areas. They are capable of adapting themselves to great variation in the composition of the water, as must necessarily be the case with any inhabitant of the Salt Lake, for that body of water is subject to wide fluctuations in bulk and composition. Aside from the long periods of rising and falling of the waters, there are great annual variations caused by the relative supply of water through rain and ow-fall and the loss by evaporation. Beside the annual fluctu- the lake is at present steadily falling, and the waters are ently growing more concentrated. I have specimens of

artemia gathered from the lake in September, 1892, and the water taken then showed on analysis 14,623.23 grains of dissolved solids to the imperial gallon, the greater part of this being salt. Indeed I have captured the creatures in the evaporating ponds of the salt works, where the brine was near its point of saturation. It is not difficult to accustom them to a diluted medium; I have kept them alive for days in lake water diluted with 25, 50, 80, and 90 per cent. fresh water, and from eight to eighteen hours in fresh water only. Of course the changes from brine to fresh water were made gradually.

As to their food, in captivity they live upon meat, bread, or vegetables, and in fact upon almost anything in the nature of food, and they are not slow in attacking the bodies of their own dead. In the lake they probably subsist on the organic matters carried down by the rivers, upon the marine algæ which flourish about the shores, and upon the dead larvæ and the pupa cases of a fly, which are found in the water in great numbers.

During a cruise upon the lake in September of the present year the crustaceans were found in great abundance. When near the middle of the lake, with a small tow net, we soon took a quart of the shrimps, and thereupon resolved upon an experiment the subsequent recital of which has shocked the gastronomic sensibilities of some of my dearest friends. Reasoning that the bodies of the artemiæ were composed largely of chitin, we concluded that the question of their palatability was at least worthy of investigation. By a simple washing with fresh water the excess of lake brine was removed, after which the shrimps were cooked with no accompaniments save a trifle of butter and a suggestion of pepper. They were found to be actually delicious. If the artemiæ could be caught and preserved in quantity, I doubt not they would soon be classed as an epicurean delicacy.

The mounting of the crustaceans for permanent microscopical use is by no means a simple undertaking, most of the ordinary media causing the delicate structure to become distorted, or producing such a transparency as to render the whole object invisible. The method which I now use is to mount them in a preparation of lake water, with corrosive sublimate and an alcoholic solution of carbolic acid. Into this fluid the living artemiæ are transferred directly from the lake brine; they die quickly, but in so doing spread themselves out most perfectly. By this method it is not always possible to get the mount free from foreign particles, but this is but a slight disadvantage. Before mounting I make a very shallow cell of hot paraffin and balsam, and after the cover-glass is in position I ring the edge with a very little of the same material, following this with repeated layers of cement, King's preferred.

The popular literature of the day still declares that no living

thing can exist in the Great Salt Lake. The perpetuation of this error is inexcusable. It is true, but very few species of animal life have been found in the concentrated brine of the lake, but some of these species there abound. Among the forms of life already reported as existing in the lake I have confirmed the presence of four: (1) the *Artemia fertilis* (Verrill); (2) the larvæ of one of the Tipulidæ, probably *Chironomus oceanicus* (Pack); (3) a species of Corixa, probably *Corixa decolor* (Uhler); (4) larvæ and pupæ of a fly, *Ephydra gracilis* (Pack). Of the last-named insect the larvæ are found in numbers near the shore, and the pupa cases in the spring and summer wash ashore in great numbers; there they accumulate, undergoing decomposition with powerfully odorous emanations.

Much has been said at different times as to the possibility of adapting fish to a life in the lake. In the absence of all experiment it would be rash to conjecture, though it would seem unlikely that fish could thrive in such a brine; but the fear expressed by some, that even if fish could be accustomed to the lake they would starve, is unfounded: for certainly the food supply is abundant. The vegetable life of the lake is a subject worthy of investigation and one which at present is practically untouched. —*From American Monthly Microscopical Journal, December, 1892.*

QUERIES AND ANSWERS.

Questions of all sorts relating to microscopy will be received by the publisher and referred to Dr. S. G. Shanks, of Albany, N. Y., whose replies will be given in this department. Each question is numbered for future reference.

122. *Can leaves and flowers of small plants be mounted entire and show cells, etc.?*

Few leaves are thin enough to show structure when mounted entire. Harden the leaves in alcohol; this will also bleach them; place them in absolute alcohol, then in oil of cloves, thence to balsam on a slip. Leaves may be stained with hæmatoxylin or carmine before placing them in absolute alcohol. Fern leaves or [illegible]s show fairly well mounted in this manner.

123. *I have an Abbe condenser with a B. and L. substage attachment. How shall I manage it to produce a dark-field illumination? Where should the light be placed? Should the diaphragms be perfectly circular?—A. E. S.*

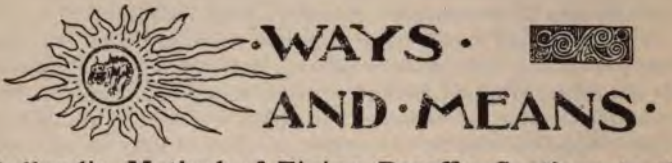
The condenser must be accurately centred with the microscope—a cap with a minute central hole fitting over the top lens is usually provided; use an inch objective on the microscope; place the cap on the condenser, focus the objective on this cap and bring the small hole to the centre of the field by means of the substage centering screws or other adjustment on the substage ring. The lamp should stand conveniently near, say about 18 inches, preferably to the left. Use the plane mirror to reflect the light into the condenser; remove the perforated cap when the condenser has been centred. For dark-field illumination, remove all diaphragms or open wide the iris diaphragm (if one is attached), and slip into place a central stop—that is, a diaphragm with the centre stopped, and an annular marginal opening; move the condenser up or down until the object is properly illuminated.

Each objective requires a suitable position of the condenser, and wide angle objectives will perform better with wide diaphragm openings; a large condensing lens placed at its focal distance from the lamp flame so as to throw parallel rays upon the mirror will largely prevent color fringes in the images; a white sun-lit cloud is the best illuminant, but not always available. The diaphragms should be circular, but a slight irregularity will not be important for ordinary work; practise with the condenser, using a familiar mount and different objectives. Diffusion of the light by lowering the condenser does not give as sharp definition as a close position under the mount, using a small central opening suited to the objective; with very wide angled objectives make an immersion contact between the top lens of the condenser and the mount with a drop of glycerine or of homogeneous immersion fluid for best results. For resolutions of difficult diatoms a diaphragm with a hole near one margin should be used to throw a very oblique pencil of light from a direction at right angles to the striæ or markings on the object.

124. *What microscopical work can be done in winter by an amateur who has no material?—H. H. S.*

Go to the nearest pond or permanently wet ditch and gather half a pint of bottom mud and two quarts of the water; place all in a glass jar in a north window. In a few days life will develop from spores and eggs. Diatoms, rotifers, cyclops, worms, moss, etc., will afford objects for study. Mount and study the different textile fibres—cotton, silk, wool, mohair, jute, hemp, flax, etc. The small branches of woody plants may be sectioned with a razor and studied. Prepare mounts of chemical crystals and

starches, common drugs and their adulterations. Plant beans, corn, and other seeds, and study the development of roots and stems. Practise free-hand sectioning—that is, holding the material in the fingers, or, if too small, imbedded in a piece of carrot, and thin slices cut with a razor flooded with water or alcohol; this very useful accomplishment will enable one to make speedy examinations of material and so determine its value for more careful investigation, and surprisingly handsome sections can be cut by a practised hand. The writer has many such hand-cut sections, originally intended for temporary study, but found worthy of permanent preservation.



Gulland's Method of Fixing Paraffin Sections to the Slide.—After pointing out the difficulties arising from the use of the albumen fixative, the author offers the following method:

The tissue is imbedded in the usual manner. In trimming the block for sectioning, care must be taken to see that the surface meeting the razor is exactly parallel to the opposite surface; these surfaces are then coated with soft paraffin, and when this has hardened are again trimmed square. The reason for this special care is that any curve in the ribbon produced by neglect of this precaution is accentuated by the later flattening of the sections. When all the sections required have been cut, the ribbon is divided into lengths corresponding to that of the cover-glass in use.

A flat glass dish filled with warm water is now provided; the temperature should never be high enough to melt the soft paraffin holding the sections together. Short of this, however, the warmer the water the more rapidly and completely are the sections flattened.

The ribbons are seized at one end with forceps while the other end is gently lowered upon the surface of the warm water; as the sections flatten out they will move along the surface of the water; when the flattening is complete, the slide, carefully cleaned, is immersed in the water. The ribbon is floated into its position with a stiff brush; this process is repeated until the slide is full, when it is set up on end until the water is thoroughly drained off. The slide is then transferred to the top of the imbedding oven, where the temperature is a little under 50° C., and where, quently, the paraffin of the sections is not melted, though

the water rapidly evaporates. The slides are kept there with a card-board cover over them to keep off dust, until the evaporation is complete and the sections adhere to the slide. The time required for this varies according to the thickness of the sections; for thin sections one hour is generally sufficient for complete fixation, but the important point is that *the paraffin must never be melted until the last trace of water has disappeared from the slide*. If this premature melting happens by any accident, the secitons are certain to peel off later. A few experiments enables one to be sure of the point when the slides are safe.

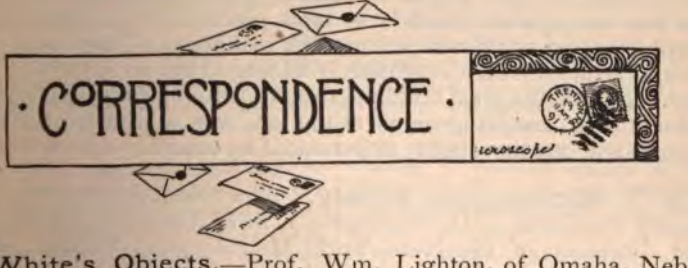
After complete fixation the paraffin is melted by putting the slide inside the oven and then washed off with turpentine or xylol.

One of the great advantages of this method is the perfect ease and safety with which it allows sections on the slide to be manipulated, so that the most various stains and reagents can be applied successively to a slide, *e. g.*, the complicated processes used to demonstrate bacteria in the tissues can be applied, with the certainty, moreover, that there is nothing on the slide to be stained which was not in the section.—*American Naturalist, November, 1892.*

Using Oil-Immersion Objectives.—In using these objectives cleanliness is important. Only a small quantity of the immersion fluid (specially prepared cedar oil) should be used, and it should be wiped off as soon as possible when done using.

To remove the oil, blotting-paper should be used, and then, breathing on the front lens, wipe it lightly with a piece of clean, soft linen.

In order to keep the immersion fluid unchanged, it should not be exposed to the air for any length of time, as exposure to the air will thicken it, and so alter the refractive index.—*E. Pennock.*



White's Objects.—Prof. Wm. Lighton, of Omaha, Neb., writes:

"The specimens of White's preparations you sent me are truly magnificent. Nothing better can be found."

ITEMS

Mr. E. H Griffith, the well-known microscopist, and family have located in Chicago, Ill. Their present address is 5656 Washington avenue, that city.

Washington Microscopical Society, for the cultivation and advancement of microscopical science, filed articles of incorporation at a recent meeting. The officers are V. A. Moore, president; E. A. Gibbs, vice-president; W. W. Alleger, corresponding secretary; L. M. Moores, recording secretary; J. M. Yznaga, treasurer, and W. H. Seaman, curator.

Bausch & Lomb Optical Co.—In speaking of the visit to this well-known firm's optical works during the recent meeting of the American Microscopical Society in Rochester, the society's report says: "Nearly two hours were occupied by the visitors in inspecting the works and in endeavoring to see at a glance what could not be satisfactorily seen in two days. All of the five hundred employés of the factory were at work, and the tour of the various departments was extremely interesting. All questions were answered by the guides with the utmost courtesy; the spectacled professor was enabled to see just how his spectacles were made, from the edge of the rim to the centre of the lens; the enthusiastic microscopist could there watch his instrument grow under his eyes, from its beautiful heavy brass standards to the tiny lens against which he so often places his eye; the photographic expert could here witness the making of all the finest apparatus which modern invention is adding to the art of photography. In fact, the great building, from its throbbing Corliss engine below to its classifying-rooms at the top, was a rare treat to the visitors and one thoroughly appreciated by them.

N. Y. Microscopical Society.—At a recent meeting of this society President J. D. Hyatt gave a brief history of the origin and formation of the New York Microscopical Society, and presented to the society an original copy of the call for the first meeting, together with the minutes of the first six meetings and other papers of historical interest.

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THE MICROSCOPE.

AN ILLUSTRATED MONTHLY DESIGNED TO POPULARIZE THE SUBJECT OF MICROSCOPY.

Edited by

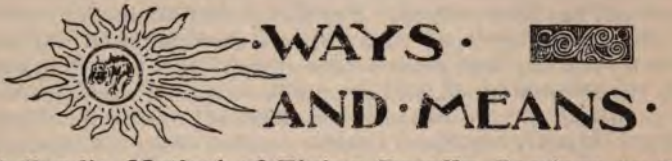
CHAS. W. SMILEY, A. M.

VOL. I, NEW SERIES. (NOS. 1-12).

1893.

Published by The Microscopical Publishing Co.
Washington, D. C.

starches, common drugs and their adulterations. Plant beans, corn, and other seeds, and study the development of roots and stems. Practise free-hand sectioning—that is, holding the material in the fingers, or, if too small, imbedded in a piece of carrot, and thin slices cut with a razor flooded with water or alcohol; this very useful accomplishment will enable one to make speedy examinations of material and so determine its value for more careful investigation, and surprisingly handsome sections can be cut by a practised hand. The writer has many such hand-cut sections, originally intended for temporary study, but found worthy of permanent preservation.



Gulland's Method of Fixing Paraffin Sections to the Slide.—After pointing out the difficulties arising from the use of the albumen fixative, the author offers the following method:

The tissue is imbedded in the usual manner. In trimming the block for sectioning, care must be taken to see that the surface meeting the razor is exactly parallel to the opposite surface; these surfaces are then coated with soft paraffin, and when this has hardened are again trimmed square. The reason for this special care is that any curve in the ribbon produced by neglect of this precaution is accentuated by the later flattening of the sections. When all the sections required have been cut, the ribbon is divided into lengths corresponding to that of the cover-glass in use.

A flat glass dish filled with warm water is now provided; the temperature should never be high enough to melt the soft paraffin holding the sections together. Short of this, however, the warmer the water the more rapidly and completely are the sections flattened.

The ribbons are seized at one end with forceps while the other end is gently lowered upon the surface of the warm water; as the sections flatten out they will move along the surface of the water; when the flattening is complete, the slide, carefully cleaned, is immersed in the water. The ribbon is floated into its position with a stiff brush; this process is repeated until the slide is full, when it is set up on end until the water is thoroughly drained off. The slide is then transferred to the top of the imbedding oven, where the temperature is a little under 50° C., and where, consequently, the paraffin of the sections is not melted, though

the water rapidly evaporates. The slides are kept there with a card-board cover over them to keep off dust, until the evaporation is complete and the sections adhere to the slide. The time required for this varies according to the thickness of the sections; for thin sections one hour is generally sufficient for complete fixation, but the important point is that *the paraffin must never be melted until the last trace of water has disappeared from the slide.* If this premature melting happens by any accident, the secitons are certain to peel off later. A few experiments enables one to be sure of the point when the slides are safe.

After complete fixation the paraffin is melted by putting the slide inside the oven and then washed off with turpentine or xylol.

One of the great advantages of this method is the perfect ease and safety with which it allows sections on the slide to be manipulated, so that the most various stains and reagents can be applied successively to a slide, *e. g.*, the complicated processes used to demonstrate bacteria in the tissues can be applied, with the certainty, moreover, that there is nothing on the slide to be stained which was not in the section.—*American Naturalist, November, 1892.*

Using Oil-Immersion Objectives.—In using these objectives cleanliness is important. Only a small quantity of the immersion fluid (specially prepared cedar oil) should be used, and it should be wiped off as soon as possible when done using.

To remove the oil, blotting-paper should be used, and then, breathing on the front lens, wipe it lightly with a piece of clean, soft linen.

In order to keep the immersion fluid unchanged, it should not be exposed to the air for any length of time, as exposure to the air will thicken it, and so alter the refractive index.—*E. Pennock.*

White's Objects.—Prof. Wm. Lighton, of Omaha, Neb., writes:

"The specimens of White's preparations you sent me are truly magnificent. Nothing better can be found."

the ocular. Cloudiness or particles of dust on any part of the ocular may be detected in this way.

Dust or Cloudiness on the Objective.—Employ the same ocular and objective as before, and the fly's wing as object. Focus and light well, and observe carefully the appearance. Rub glycerin on one side of a slide near the end. Hold the clean side of this end close against the objective. The image will be obscured, and cannot be made clear by focusing. Then use a clean slide, and the image may be made clear by elevating the body slightly. The obscurity produced in this way is like that caused by clouding the front-lens of the objective. Dust would make a dark patch on the image that would remain stationary while the object or ocular was moved.

If too small a diaphragm is employed, only the central part of the field will be illuminated, and around the small light circle will be seen a dark ring.

Relative Position of Objects or parts of the same object.—The general rule is that objects highest up come into focus *last* in focusing up, *first* in focusing down.

Objects Having Plane or Irregular Outlines.—As object use three printed letters mounted in stairs in Canada balsam. The first letter is placed directly upon the slide, and covered with a small piece of glass about as thick as a slide. The second letter is placed upon this and covered in like manner. The third letter is placed upon the second thick cover and covered with an ordinary cover-glass. The letters should be as near together as possible, but not overlapping. Employ the same ocular and objective as before.

Lower the tube till the objective almost touches the top letter, then look into the microscope, and slowly focus up. The lowest letter will first appear, and then, as it disappears, the middle one will appear, and so on. Focus down, and the top letter will first appear, then the middle one, etc. The relative position of objects is determined exactly in this way in practical work.

Transparent Objects Having Curved Outlines.—The success of these experiments will depend entirely upon the care and skill used in preparing the objects, in lighting, and in focusing.

Employ a 5 mm. (1-5 in.) or higher objective and a high ocular for all the experiments. It may be necessary to shade the object to get satisfactory results. When a diaphragm is used the opening should be small.

Air Bubbles.—Prepare these by placing a drop of thin mucilage on the centre of a slide and beating it with a scalpel blade until the mucilage looks milky from the inclusion of air bubbles. Put on a cover-glass but do not press it down.

Air Bubbles with Central Illumination.—Shade the object; and with the plane mirror, light the field with central light.

Search the preparation until an air bubble is found appearing about 1 mm. in diameter, get it into the centre of the field, and if the light is central the air bubble will appear with a wide, dark, circular margin and a small bright centre. If the bright spot is not in the centre, adjust the mirror until it is.

This is one of the simplest and surest methods of telling when the light is central or axial.

Focus both up and down, noting that in focusing up the central spot becomes very clear and the black ring very sharp. On elevating the body still more the centre becomes dim, and the whole bubble loses its sharpness of outline.

Air Bubbles with Oblique Illumination.—Remove the substage of the microscope, and all the diaphragms. Swing the mirror so that the rays may be sent very obliquely upon the object. The bright spot will appear no longer in the centre but on the side *away from* the mirror.

Oil Globules.—Prepare these by beating a small drop of clove oil with mucilage on a slide and covering as directed for air bubbles.

Oil Globules with Central Illumination.—Use the same diaphragm and light as above. Find an oil globule appearing about 1 mm. in diameter. If the light is central the bright spot will appear in the centre as with air. Focus up and down as with air, and note that the bright centre of the oil globule is clearest *last* in focusing up.

Oil Globules with Oblique Illumination.—Remove the substage, etc., as above, and swing the mirror to one side and light with oblique light. The bright spot will be eccentric, and will appear to be on the *same* side as the mirror.

Oil and Air Together.—Make a preparation exactly as described for air bubbles, and add at one edge a little of the mixture of oil and mucilage; cover and examine.

The substage need not be used in this experiment. Search the preparation until an air bubble and an oil globule, each about 1 mm. in diameter, are found in the same field of view. Light first with central light, and note that in focusing up the air bubble comes into focus first and that the central spot is smaller than that of the oil globule. Then, of course, the black ring will be wider in the air bubble than in the oil globule. Make the light oblique. The bright spot in the air bubble will move *away from* the mirror, while that in the oil globule will move *toward* it.

Air and Oil by Reflected Light.—Cover the diaphragm or mirror so that no transmitted light can reach the preparation, using the same preparation. The oil and air will appear like globes of silver on a dark ground. The part that was darkest in

each will be lightest, and the bright central spot will be somewhat dark.

Distinctness of Outline.—In refraction images this depends on the difference between the refractive power of a body and that of the medium which surrounds it. The oil and air were very distinct in outline, as each differed greatly in refractive power from the medium which surrounds them, the oil being more refractive than the mucilage, and the air less.

Place a fragment of a cover-glass on a clean slide, and cover it. The outline will be very distinct with the unaided eye. Use it as object and employ the 18 mm. ($\frac{3}{4}$ in.) objective and high ocular. Light with central light. The fragment will be outlined by a dark band. Put a drop of water at the edge of the cover-glass. It will run in and immerse the fragment. The outline will remain distinct, but the dark band will be somewhat narrower. Remove the cover-glass, wipe it dry, and wipe the fragment and slide dry also. Put a drop of 50% glycerin on the middle of the slide and mount the fragment of cover-glass in that. The dark contour will be much narrower than before.

Draw a solid glass rod out to a fine thread. Mount one piece in air, and the other in 50% glycerin. Put a cover-glass on each. Employ the same optical arrangement as before. Examine the one in air first. There will be seen a narrow, bright band, with a wide dark band on each side.

The one in glycerin will show a much wider bright central band, with the dark borders correspondingly narrow.

If the glass rod or any other object were mounted in a medium of the same color and refractive power, it could not be distinguished from the medium.

Study of Germinal Layers of Petromyzon.—Mr. S. Hatta hardened the eggs and larvæ of *Petromyzon* partly in Kleinenberg's picro-sulphuric acid, and partly in corrosive sublimate. A few larvæ were also killed in Flemming's solution. The sublimate specimens gave the best result. Picrocarmine was found to be the best staining agent, as, being a nuclear stain and not affecting the yolk granule, it made observation comparatively easy. —*Journal Coll. Sci. Imp. Univ. Japan*, *v* (*1892*).

Preparation of Vegetable Tissues.—Mr. A. Flatters, in the Transactions of the Manchester Microscopical Society, 1891, pp. 38–47, gives detailed instructions in the use of the microtome and the cutting of sections of vegetable tissues, the preparation of leaf and flower-buds, the mounting of celloidinized sections, and the staining of vegetable tissues with logwood and with borax-carmine and iodine-green. Formulæ are given for preparing Kleinenberg's hæmatoxylin, picrocarmine, borax-carmine, and glycerine-jelly.

PHOTOMICROGRAPHY.

By F. A. Rogers, M. D.,

WORCESTER, MASS.

Photomicrography is the art of photographing the enlarged image of a microscopical object. It is the opposite of microphotography, which consists of microscopical photographs or reduced images of large objects or pictures, and which have little, if any, value except as curiosities.

When the amateur landscape photographer makes up his estimate of the requisites to pursue his coveted line of experiments, he is at first met with the expense of a suitable lens, for upon this depends in a great measure his success, while in photomicrography the objective, with or without the ocular, supplies the lens needed. Any good objective will give a good photomicrograph if properly manipulated.

It is best to begin with a low power, say a one-inch or three-fourths-inch or even lower, and aim to secure a sharp negative with good contrasts and of medium size. Be content with moderate amplification and good definition. If greater amplification is desired use a higher power objective rather than use a higher ocular with a low-power objective. Sunlight is by far the best for this purpose, yet excellent work can be done with lamplight.

By employing the most simply constructed home-made apparatus and suiting the convenience of the operator, either by sunlight, preferably, or by employing a single-wick kerosene burner with the flame placed edgewise in the optical axis of the apparatus, the principles of photomicrography can be easily illustrated and beneficially employed.

Before attempting to pursue this art, several preliminaries should receive attention. A dark room is one of the needed conveniences, and unless work is to be done wholly at night it becomes a necessity. Some unoccupied, darkened room, ample closet, or even a corner of a rough room may be suitably arranged for the purpose. It should be light-tight, contain a small sink and have running water if possible, but a suspended pail provided with a few feet of rubber tubing with a nipper-tap attached will answer the purpose of a reservoir and piping, while a small tub with a shelf inserted or board across the top may economize the sink. The room should contain a small stand, and two or three shelves are very convenient.

The paraphernalia needed to work with are a ruby lantern; three trays—one for developing, one for fixing, and one for toning (they should be so marked that they may not get mixed); three graduates—one eight-ounce, one two-ounce, and a minim glass; a plate lifter; one printing frame; Omega paper; Omega toning

solution; one sheet of ferrotype plate; squegees; broad camel's-hair brush; plates; plate-holder; focusing glass; camera; a pair of scales suitable for weighing grains; card mounts; parlor paste; and negative varnish.

The following chemicals are needed: 1 lb. each of sulphite of sodium, carbonate of potassium, chrome alum, hyposulphite of sodium, and carbonate of sodium; one ounce each of sulphuric acid, bromide of potassium, caustic soda, pyrogallic acid, and hydrochinon.

Several other things, such as a drying rack, intensifier, etc., could be added with advantage. To those who are financially able I would say select a good serviceable camera with several kits and one arranged for manipulating the micrometer screw at the end. With this instrument different sized plates may be used, and there is a certain satisfaction in using an instrument with all the modern improvements, but equally good results may be obtained with far less expensive apparatus; in fact, good work may be done by any one with a little ingenuity, by constructing a camera to fit the plate-holder. The most convenient size is the 4 x 4 or 4 x 5 plate. Select a good plate-holder for the above sized plate and fit it light-tight by means of a narrow ledge to a board 5 x 6 inches, which has a circular hole three and one-half inches in diameter in the centre.

Make a paper cone of black sheathing paper, 18 inches long, three and one-half inches in diameter at one end and large enough at the other to admit the draw-tube of the stand or ocular. Tack it to the inside of the hole in the board and at a right angle to it. Fill up all the chinks with sealing-wax and paint the parts that might reflect light upon the plate a dull black and we have a serviceable camera at no expense except the time of making.

Make a small frame that shall fit the board in the place of the plate-holder, and which contains a piece of ground glass for focusing upon, and support the whole thing firmly and permanently upon one end of a base-board, about one foot wide and four feet long, at such a height that when the microscope is turned back at a right angle the upper end of the draw-tube may enter therein.

As will be inferred from the above, the proper position for the microscope is to incline the body at a right angle with the base, but this is rendered necessary only from the position of our improvised camera and for convenience in manipulating.

I have found Carbutt's special, quick as lightning, blue label, plates to be very well adapted to the needs of this work. I should recommend that one select a good plate, and not change unless for some good reason, as we soon learn the peculiarities of each kind, and thus are better fitted to meet with emergencies and conditions which another plate might not possess. And,

again, any one will learn after repeated trials the exposure necessary, being guided by the intensity of light upon the ground glass. This varies with different plates and is another reason why one kind of plate should be adhered to.

There seems to be a variety of opinion with regard to the use of an ocular. Personally I do not use the ordinary Huyghenian ocular in photomicrography except in focusing as hereafter illustrated. Oculars especially corrected for this work may be obtained, but unless one is at hand I have found it best to use only the objective, which, if a good one, will give good results. I am aware, however, that there are those who hold a different opinion upon this point.

Microscopical enlargements are often, though improperly, expressed in "times" when diameters are intended. It is evident that if an object one-thousandth of an inch in diameter be made to appear one inch in diameter it has been magnified one thousand diameters, while the area has been increased one million times.

A few words in regard to the object to be photographed may not be amiss here. As we always use light transmitted through the object, it is obvious that objects which produce the greatest contrast in lights and shadows are the best for our purpose. The picture, while possessing little or no perspective, may show a great amount of detail.

The coloring of the object is another important point to consider. Sections stained with brown, black, or Heidenhains' impregnation give finer results than those stained with picro-carmine or blue. The part of a section to be photographed should be carefully selected by direct examination. It should be thin enough to show the desired details plainly, and, if possible, the coloring should give a good contrast of lights and shadows.

For all objectives of less power than a one-fourth or one-fifth, if the object be illuminated by sunlight, I would not use a substage condenser, but for a one-fifth or higher power I would use it.

As has been said, sunlight is the best source of light; electricity and the magnesium light have been employed, but for the majority of workers they are not practicable. In using sunlight a heliostat is a luxury which most cannot afford, but it is a convenience which all who attempt photomicrography, using solar light, would appreciate. Evidently the light must be reflected, and a mirror mounted upon a support so that it can be readily turned in any direction is a very nice adjunct to the opposite end of our camera board.

This can be easily arranged as follows: Remove the mirror and support from the mirror-bar and make a clasp of a piece of brass three inches long, three-eighths of an inch wide, and one-fourth of an inch thick by turning up one-half inch on either end. In one end fit a small screw that will bear

against the rim of the mirror, and solder a small hook of brass or copper wire to either end of the clasp. This is to be fastened across the concave surface, diametrically opposite to the fork which holds the mirror, leaving the plane surface free to reflect the light. The centre of a rather stout wire eight inches long is to be fastened by clamp or string to the lower part of the mirror-fork in a direction opposite to the first clasp. Make a small hook on either end of the wire. Let the mirror, fork, base-piece and clasps attached be clamped in an upright position at such a height that the centre of the mirror shall be on a line with the optical axis of the other parts.

Now construct a wooden frame that shall hold a roller as follows: Let it be eight inches long and one inch wide and consist of a base-piece with an upright two inches long fastened to either end. The wooden roller is one inch in diameter, long enough to reach between the uprights, and arranged to revolve on its axis between the ends. By means of a screw fasten the frame at its centre to the base-board under the camera-cone in a handy position, so that it may be turned in a horizontal direction. Let a string run from the hook on one end of the first clasp through a small screw-eye under the mirror, around the roller twice, back through a screw-eye, and attach to the other end of the clasp. From either end of the frame that supports the roller extend a string to the end of the stout wire fastened to the mirror-fork. It is evident that any position of the mirror may now be obtained by manipulating the wooden frame and roller.

But the mirror attached to the microscope, though far less convenient than the above arrangement, may be made to answer the purpose, and, although a little intractable at first, one soon learns to guide the beam aright. The beam must pass through the optical axis of condenser, objective, microscope tube, and camera to produce the right results. If eccentric, the image will be improperly illuminated, or distorted. If no condenser is employed, a diaphragm should be substituted. The size of orifice can be determined by noting the best result of definition, especially in the periphery of the illuminated circle upon the ground glass. In using the condenser, rack it back and forth from the stage until the best result is obtained, or until the field is equally lighted in all parts, then shut off the extra light with a proper diaphragm, or preferably by using the iris diaphragm if it has one attached, until the definition is the best that can be attained. A little experience will enable one to arrange the condenser in the best position for obtaining a good, sharp negative.

[*To be continued.*]

AMERICAN SOCIETIES INTERESTED IN MICROSCOPY.

By Chas. W. Smiley,

WASHINGTON, D. C.

For two years past the editor of this periodical has been collecting statistics of American microscopy. Among the questions asked was this: "What societies in your vicinity give attention to microscopy?" Out of a large mass of replies the following list has been compiled. All of the more important societies are doubtless included, but in order to secure data for its absolute perfection a premium is now offered for each additional name of a society devoted wholly or in some reasonable degree to microscopy. The premium will be a nicely mounted slide, or a year's subscription to the *Microscope*, at the option of the person first furnishing the information.

Most scientific and medical societies listen to papers occasionally in which allusion is made to microscopical work, but in order that such societies be enumerated in this list it is necessary that they indicate in some way an especial interest in this subject. This may be shown by the possession of a collection of mounted slides, by a good collection of books on microscopy, by meetings being held for the especial benefit of microscopists, or by the formal declaration that microscopy is one of the objects of the formation of the society.

A marked copy of the issue containing this list will be sent to each society's secretary. Upon its receipt, he is earnestly requested to return to us answers (numbered to correspond) to the following questions. The desired information when published will be of mutual benefit to all.

1. In what year was the society organized?
2. In what year incorporated (if at all)?
3. Has it printed copies of its constitution for distribution?
4. What is the regular time for meetings?
5. How many members (specify active, honorary, etc.) has it?
6. What are the membership fees?
7. What microscopes and accessories does it own?
8. About how many mounts has it?
9. How many books, pamphlets, etc.? (Specify the most important.)
10. What is the average attendance at meetings?
11. How is an account of the meetings published?
12. Who are the president, secretary, and treasurer for 1893?
13. Add any other items of general interest and specify to what extent the society is devoted to other subjects than microscopy.

Provisional List of Fifty Societies.

United States.—American Society of Microscopists (migratory), W. H. Seaman, Sec'y, Washington, D. C.

California.—San Francisco Microscopical Society, San Francisco, Cal., Geo. Otis Mitchell, Sec'y.

Colorado.—Denver Microscopical Club, Denver, Colo.

Connecticut.—New Britain Scientific Association, New Britain, Conn., M. S. Wiard, Sec'y.

New Haven Microscopical Club, New Haven, Conn., Thos. G. Lee, M. D., Sec'y.

District of Columbia.—Washington Microscopical Society, Washington, D. C., L. M. Mooers, Sec'y.

Illinois.—Illinois State Microscopical Society, Chicago, Ill. Wm. Haskins, Sec'y, 81 Clark street.

Dixon Biological Society, Dixon, Ill., Ira W. Lewis, Sec'y.

Peoria Scientific Association, Peoria, Ill.

Kansas.—Sphinx Society, Atchison, Kans., Prof. E. B. Knerr, Sec'y.

Leavenworth Microscopical Society, Leavenworth, Kans., W. D. Bidwell, Sec'y.

Kentucky.—Louisville Microscopical Club, Louisville, Ky.

Maine.—Androscoggin Microscopical Society, Auburn, Me., C. E. Williams, M. D., Sec'y.

Natural History Society, Portland, Me., C. B. Fuller, Curator.

Massachusetts.—Taunton Microscopical Society, Taunton, Mass., Dr. F. A. Hubbard, Sec'y.

Natural History Society, Worcester, Mass.

Michigan.—Griffith Microscopical Society, Detroit, Mich.

Minnesota.—Northwestern Microscopical Society, St. Paul, Minn.

Missouri.—St. Louis Club of Microscopists, St. Louis, Mo., S. E. Barber, Sec'y.

St. Louis Microscopical Society, St. Louis, Mo.

Nebraska.—Lincoln Microscopical Club, Lincoln, Nebr., Roscoe Pound, Sec'y.

Omaha Microscopical Society, Omaha, Nebr., Dr. Wilkeson, Sec'y.

New Jersey.—Essex County Microscopical Society, East Orange, N. J.

New Jersey State Microscopical Society, New Brunswick, N. J., F. C. Van Dyck, Sec'y.

Natural History Society, Trenton, N. J.

New York.—Department of Microscopy, Brooklyn Institute, 200 Washington street, Brooklyn, N. Y., F. H. Hooper, Sec'y, 71 St. James Place, Brooklyn, N. Y.

Microscopical Club of the Buffalo Society of Natural History, Buffalo, N. Y., S. Hobart Dorr, Sec'y.

Naturalist's Field Club, Buffalo, N. Y., M. A. Fleming, Sec'y.

Buffalo Microscopical Club, Buffalo, N. Y., James W. Ward, Sec'y.

UpDeGraff Microscopical Section, Academy of Sciences, Elmira, N. Y.

Fredonia Microscopical and Natural Science Club, Fredonia, N. Y., Nelson G. Richmond, M. D., Sec'y.

Jamestown Microscopical Society, Jamestown, N. Y., S. W. Baker, Sec'y.

New York Microscopical Society, 64 Madison avenue, New York, J. L. Zabriskie, Flatbush, N. Y., Sec'y.

American Microscopical Society of New York City.

Nyack Society of Microscopists, Nyack, N. Y., Miss Edith Stillwell, Sec'y.

Academy of Sciences, Rochester, N. Y. (in the Botanical Section there are frequently microscopical exhibits), Frank C. Baker, Sec'y.

Microscopical Club of Central New York, Syracuse, N. Y., W. H. Olmsted, Sec'y.

Troy Scientific Association, Troy, N. Y.

Postal Microscopical Club, Troy, N. Y., Dr. S. G. Shanks, Sec'y.

Ohio.—Cleveland Microscopical Society, Cleveland, Ohio, R. Dayton, Sec'y.

Microscopical Section, Natural History Society, Cincinnati, Ohio.

Pennsylvania.—Biological and Microscopical Section, Academy of Natural Sciences, Philadelphia, Pa., H. Wingate, Sec'y.

West Chester Microscopical Society, West Chester, Pa., F. McClurg, Sec'y.

Lehigh Valley Microscopical Society, Easton, Pa., Edgar M. Green, M. D., Sec'y.

Iron City Microscopical Society, Pittsburg, Pa , Geo. H. Clapp, Sec'y.

Rhode Island.—Providence Franklin Society, Providence R. I., H. S. Hathaway, Sec'y.

Virginia.—Richmond Microscopical Society, Richmond, Va.

Canada.—Microscopical Section, Entomological Society of Ontario, London, Ont., J. Alston Moffatt, Sec'y.

Montreal Microscopical Society, Montreal, Canada, L. J. Skelton, Sec'y.

Victoria Natural History Society, Victoria, B. C., Dr. Newcombe Pres't.

Corrections and additions to the above list are requested, and will be published.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Photomicrography.—No branch of microscopy has made such rapid progress in the past few years as this, but there is a constant demand for information as to the best methods, and especially for inexpensive methods. The beau ideal is of course to secure methods which, at the same time, are simple and inexpensive.

There is presented in *The Microscope* for January and February an article, by Dr. F. A. Rogers, which will prove of much value to any who desire to learn the subject. The entire outfit will not cost more than ten dollars, exclusive of microscope, and the directions are so easily understood that a lad of sixteen years may learn to take good pictures, while microscopists with but little time to experiment may reach satisfactory results by trusting themselves entirely to Dr. Roger's guidance.

Answers to Queries.—It often happens that a reader could give a different answer or some interesting details concerning the queries and answers which we are publishing. We accordingly invite all our subscribers to send notes, criticisms, suggestions, and items suggested to their minds by the perusal of our Queries and Answers.

This year, for the purpose of stimulating thought, we shall publish questions unaccompanied by answers, and in the hope of receiving quite a number of different volunteer replies. Such as prove of interest will be published in *a succeeding* number of THE MICROSCOPE.

PRACTICAL SUGGESTIONS.

Light.—The best light to use for microscopic work is daylight, and the best daylight comes from a uniform gray cloud. A pure blue sky does not give the fullest power to a high objective. Avoid quickly passing clouds and direct sunlight. Set the microscope six or eight feet from the window.

Arithmetical Microscopy.—The best book on the theory and mathematics of the microscpe is Naegeli and Schwendener's Microscope in Theory and Practice, an English edition of which has been published by Macmillan & Co., New York. Most of it is too abstruse for any but professional microscopists.

The Eyes.—A friend of ours recently forbid his son to use the microscope because the young man's eyes were not strong, and further injury was feared. But with care one may learn to use the eyes a large amount without injury. Do not use a microscope for an hour after eating, nor in the early morning. Alternate the use of the eyes and habituate both to the use of the tube. Always discontinue work when the eyes show signs of fatigue.

Injuries to the Microscope.—If chloride of calcium and nitric acid, fuming hydrocloric acid, etc., are placed, when heated, close to the microscope the lacquer will be injured thereby. Similarly, sulphureted hydrogen, volatile acids, chlorine, and many gases developed in chemical operations will attack the instrument. For many reasons the instrument should be kept under cover as much as possible.

Cutting.—Before cutting a section, moisten both the blade and the object in order to secure a smoother and more natural surface. Draw the knife as if it were a saw, and do not push it as if it were a chisel. Thin and troublesome objects may be allowed to solidify in gum or paraffin. They may sometimes be cut between elder-pith or cork.

Good Permanent Paste.—A strong paste that will keep for a year or longer may be made in this way: After dissolving one teaspoonful of alum in one quart of water, stir in as much flour as will give it the consistence of thick cream, being particular to break up the lumps; stir in as much powdered resin as will lie on a dime, and a half dozen cloves. Have on the fire a saucepan with a teacup of boiling water; pour the flour mixture into it, stirring well all the time. In a few minutes it will be of the consistence of porridge. Pour it into a jar, let it cool, and tie over, putting it into a cool place. When any is needed, take out a portion and soften with warm water. Its keeping qualities will be enhanced by the addition of five grains of hydronaphthol dissolved in a little alcohol.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

125. *How are permanent mounts of spider's web made ?—A. R.*

Make a thick ring of varnish on a slip; when dry, run a fresh coat of varnish over it; place the slide under a newly-made (clean) web and press it upward so some of the lines of the web will run across the varnish cell and be caught in the fresh varnish ring; set the slip aside, under cover, until the varnish is dry; add one or more coats of varnish to make a rather deep cell; cover as a dry mount. The web seems to relax somewhat and the beaded or circular lines will touch the glass and adhere if the cell is shallow. The beaded lines are best near the outer edge of the web. The beads are glutinous and will adhere and flatten against the glass weeks after the mount has been closed if the cell is not deep enough.

126. *Is the poison in cheese and ice cream a microscopic bacteria ?—G. H. B.*

This poison is probably the result of a slight putrefactive change, which is always caused by bacteria. The poison has been obtained as minute crystals, which will produce all the symptoms of cholera morbus when swallowed. The poison is volatile at the temperature of boiling water, and poisonous cheese may be eaten with impunity after being cooked. These crystals are called tyrotoxicon, meaning *cheese poison*, in Greek. See an abstract in *Am. Mo. Mic. Journal*, vol. vi, page 175.

127. *Is there any sharp distinction between fresh-water ana marine diatoms ?—W. S. B.*

This query was sent to this department several months ago and was referred to Prof. H. L. Smith, who has kindly furnished, in substance, the following information: There is no sharp distinction between fresh-water and marine diatoms. There is but one species of *Pleurosigmæ*, with diagonal striæ, occurring in purely fresh water (and it is also brackish and marine)—*P. delicatulum*. The *Grammatophora* do not occur in fresh water, still there are closely allied genera which do. If one finds *Nav. virides* or *N. major*, or *Stauroneis phœnicent*, or *S. acuta*, in a fossil mass, he may be sure that it is a fresh-water deposit. A *Triceratium* is good evidence of a marine deposit, "and yet

I have found the genus *Rhizoselenia*, hitherto only known as distinctively marine, represented by two well-marked species in our great lakes."

128. *What is the meaning of tactile hairs?—E. W. M.*

They are the long bristle-like hairs growing on the upper lip of nocturnal animals, especially, as on cats, rats, etc. They have a peculiar and abundant network of blood-vessels at the roots, and under excitement the hairs stand out erect and are sensitive, so the slightest touch on the extremity of one of them is immediately felt by the animal. These hairs assist greatly in guiding these animals when running through dark and intricate passages.

SCIENCE—GOSSIP.

Yeasts and Bacteria of Natural and Artificial Wines.—MM. Schaffer and von Freudenreich have reported on the microorganisms existing in natural and artificial wines, and, considering the method of manufacturing and composition of these latter, the authors' results are not surprising.

Of the ten natural wines examined only one contained bacteria, and this one, from imperfect treatment, had always been cloudy. Wines which had been several years in bottle were sterile, containing neither yeast nor bacteria. Artificial wines contained numerous bacteria, and the authors throw out the suggestion that the presence of these bacteria may have some connection with gastric disorders.—*Jour. Royal Micr. Society, August, 1892.*

New Method for Finding Tubercle Bacilli in Sputum.—Herr Dahmen has devised a modification of Bidert's method, the principle of which consists in separating the solid from the liquid portion of the sputum by boiling with caustic soda.

The author states that the same result may be arrived at by heating the sputum for fifteen minutes in a vapor bath. The solid particles almost immediately fall to the bottom and, after the liquid portion has been poured off, are well mixed up in a mortar and are ready for examination.—*Jour. Royal Micr. Soc., Oct., 1892.*

Staining Fibrin.—M. Sabouraud communicates in the Annales Inst. Pasteur, 1892, p. 184, a method for staining fibrin which is said to be superior to that of Weigert. Pieces of chancre fixed in Müller's fluid are placed for 15–20 hours in the following solution: Tannin $\frac{1}{20}$, alcohol 10 ccm. to 200 of the solution; they are then stained with anilin-violet (Ehrlich) and then colored by the Gram-Weigert method, in which during decoloration clove oil is substituted for analin oil.

RECENT PUBLICATIONS.

Domestic Science.—By James E. Talmage, Ph. D., Salt Lake City, Utah. Pp. 331, 93 cuts.

The perusal of this little hand-book, which the author says that he has designed for a school text-book as well as for general reading, has interested us very much. The author, who is a chemist, and well posted in physiology and physics, has treated some practical subjects of every-day life in a way to interest and instruct the young people of Utah. The policy of putting scientific truth into plain and simple language has been adhered to by Dr. Talmage without marring the dignity of science. The young people from thirteen to seventeen years of age who are not fortunate enough to go to college will derive very great and practical benefit for the duties of life by the study of such a book. This will appear from the following partial enumeration of topics: Air, ventilation, heating, lighting, the character and uses of water, the nature of food, and the chemistry of cooking, cleansing agents, poisons and their antidotes. The author has not in all cases put forward the latest claims of investigators on these topics, but has contented himself with setting forth the well-established facts.

The book was designed for strictly sectarian use. The authorities of the Church of Latter-day Saints, commonly known as the Mormon Church, have endorsed the book as being "imbued throughout with the spirit of our religion." We are glad to say, however, that the book is not very seriously tinctured with religion. The rainbow is declared to be "the seal of the covenant of the Creator with his children." The Great Creator, the All-seeing One, God's laws, etc., are alluded to repeatedly, but without sectarian bias. The book of Mormon is cited to substantiate the author's declaration that animal food can be used to excess, while strict vegetarianism is equally unphysiological. To our mind the book would lose nothing and gain much by the omission of these few religious touches. A book of science should not be used to inculcate incidentally views of government, sociology, language or religion. If the author will issue another edition, free from this objection, we shall take great pleasure in commending the book for use in certain schools throughout the entire country; for the central idea, of bringing within the grasp of all the people the practical and essential truths which science has taught us regarding every-day affairs, cannot be too highly commended. If a boy who is about to become a farmer, or a girl who is about to become a mechanic's wife, must choose between knowing grammar, arithmetic, or geography, and the scientific truths of this little book, the latter would be of infinitely more use in making life healthful and happy. If revised, as we have suggested, the index should be made strictly alphabetical.

List of Walter White's Botanical Sections and Other Objects Ready for Mounting or for Examination.

By CHAS. W. SMILEY,
WASHINGTON D. C.

	No.
Yeast. Simple globular vegetable cells, showing nucleus.	1
Crown Imperial. Root L.S. Protoplasm in cells	2
Orchid (*Oncidium*) Leaf. Fibro spiral cells, isolated	3
Elder pith T.S. Pitted thin walled parenchyma	4
Brazil nut. Pitted and reticulate thickened parenchyma cells, isolated	5
Brazil nut. Prismatic cells from shell, isolated	6
Rush T.S. Stellate parenchyma cells	7
Rush, isolated stellate parenchyma cells	8
Vegetable Ivory T.S. Thickened unlignified albumen cells. Pore canals.	9
Date stone L.S. Ditto	10
Coquilla nut T.S. Lignified parenchyma cells	11
Coquilla nut, isolated lignified parenchyma cells	12
Bullace stone, isolated lignified parenchyma cells	13
Star-anise testa, isolated lignified parenchyma cells	14
Star-anise testa, surface view, lignified parenchyma cells	15
Walnut shell T.S. Lignified parenchyma cells	16
Pear T.S. Lignified parenchyma cells	17
Pear, isolated. Lignified parenchyma cells	18
Yew, isolated wood cells (tracheides). Spiral deposit	19
Yew, radial wood cells (tracheides). Spiral and pits	20
Cinchona bark (*C. Calisaya*) T.S., thickened, bast cells, fusiform	21
Cinchona bark, isolated bast cells, fusiform	22
Periwinkle, isolated bast cells, fusiform. Stratification of cell wall	23
Flax. Long fibre cells, isolated.	24
Cotton. Hairs from seed vessel.	25
Rhubarb leaf. Spiral and annular vessels, isolated	26
Brake fern. Scalariform vessels, isolated	27
Brake fern L.S. Scalariform vessels, sieve tubes, etc.	28
Brake fern T.S. Scalariform vessels, sieve tubes, etc.	29
Brake fern, oblique sect. Scalariform vessels, sieve tubes, etc.	30
Maize. Annular vessels in fibrovascular bundle	31
Pumpkin L.S. Sieve tubes	32
Bryony L.S. Sieve tubes	33
Bryony T.S. Sieve tubes	34
Lime bark L.S. Sieve tubes.	35
Mazereon L.S. Spiral and pitted tracheides	36
Phlox. Anther. Stellate tissue of mesothecium	37
Crown Imperial. Anther Fibro spiral tissue of mesothecium	38
Crown Imperial. Anther T.S.	39
Crown Imperial. Anther. Isolated cells	40
Hayacinth, Anther. Fibro spiral tissue. Raphides	41
White water lily, peduncle T.S. Trichlobasts in air spaces	42
Water plantain, petiole T.S. Air spaces of aquatic plant	43
Sowthistle stem T.S. Collenchyma	44
Onion. Bulb scale L.S. Laticiferous vessels	45
Salsify. Root L.S. Laticiferous vessels	46
Euphorbium splendens. Stem L.S. Laticiferous vessels containing bone-shaped starch grains	47
Oak. Bark T.S. Periderm, etc.	48
Red currant. Stem T.S. Phellogen	49

No.

Elder. Young shoot T. S. Phellogen, etc. 50
Sugar cane T.S. Closed vascular bundles 51
Sugar cane L.S. Closed vascular bundles 52
Pampas grass T.S. Closed vascular bundles 53
Butcher's broom T.S. Closed vascular bundles 54
Butcher's broom L.S. Closed vascular bundles 55
Ranunculus repens. Runner T.S. Open collateral fibro vasal bundles 56
Aristolochia latifolia T.S. Interfascicular cambium . . 57
Aristolochia latifolia L.S. Interfascicular cambium . . 58
Ivy. One-year-old stem T.S. Resin cells. Scandent root. 59
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In many cases these objects have been stained, either singly or doubly, and some stained three years ago have not faded. Their very low cost commends them to every student of biology or collector of microscopic objects.

Directions for Mounting.—They may be mounted in resinous media (damar, benzol-balsam), glycerin, or glycerin jelly, the former being the easier for a beginner, while the latter, though more trouble, shows structure better.

In mounting, carefully separate the films, and remove the object. If for resinous media, soak in spirit of turpentine till clear, rinse in a fresh portion of the same, then drain, transfer to the slide, and finish as usual. For glycerin: If the object be oily, first wash out the oil with strong methylated spirit, transfer to glycerin and water, equal parts. Let it remain an hour or two, then mount. Minute objects, such as isolated cells, should be transferred on the point of a scalpel to a slide (or cover), and separated with a needle in a drop of spirit; then, if for glycerin, mount while still moist; but if for resinous media, allow to dry, then moisten with a drop of turpentine before applying the medium. Spiral and other vessels, and long fibre cells, which mat together, should be soaked in a drop of weak spirit, and a few of the most perfect picked out under a simple lens.

THE MICROSCOPE.

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PHOTOMICROGRAPHY.

By F. A. ROGERS, M. D.,

WORCESTER, MASS.

[*Continued from page 5.*]

The most particular step in the whole process of photomicrography, aside from lighting, is the focusing. We must not expect to focus "pretty good" and that the plate or developer will do the rest. If we expect to get a good sharp negative we must be sure that a good sharp image is projected upon the plate, for the plate will not lie, but will reproduce accurately the view which has impressed it.

The ground glass and plate must be in the same plane when they are exchanged; in other words, the sensitive side of the plate must occupy the identical place of the ground surface upon which the image is focused, in order that we may obtain a good negative. This becomes more important as work is attempted with higher powers, for then it is often difficult to determine when the object is just in focus; a magnifier or focusing glass now may be used with great advantage, but this magnifies the blurred and indistinct outline on the apparently much roughened surface of the ground glass. Instead of ground glass one may employ a negative which has been exposed to daylight and developed in the usual way, the film upon the surface being excellent to focus upon. Some coat the surface of the ground glass over with tallow or vaseline and claim that it improves it. But there is another method which is excellent for focusing high powers. Substitute a wooden slide for the ground glass, and let there be a hole or several holes in it large enough to receive the ocular. Have the slide of such a thickness that when the ocular is pushed in as far as it will go the diaphragm shall lie in the same plane as the surface of the ground glass. Insert it, and by this means the focusing of a one-fifteenth inch objective becomes an easy matter. This is a great improvement over the method of using a ground glass, or any other surface to focus a high power objective upon.

Before making an exposure there are several other points to observe.

1. A firm and steady support must be provided for our camera board to rest upon. No jarring is to be permitted during the exposure, as it will give a blurred image.

2. The heat rays should be intercepted by placing between the mirror and condenser, or mirror and object, a vessel with glass sides and filled with the following solution:

Sulphate of copper, . . .	175 parts.
Bichromate of potassium, . .	17 "
Water, ...	1,000 "

The vessel may be easily constructed from a pane of glass with a glass-cutter. It may be four inches square, and one-half inch between the glass sides.

3. Some means must be provided for exposing other than drawing the slide of the plate-holder, as it would disturb the adjustment. In using a low-power objective with long-working distance, a blackened card may conveniently be placed between the object and the objective, thus intercepting the rays while the slide of the plate-holder is withdrawn, when the card can be lifted long enough to make the exposure, and then replaced while the slide is returned in the plate-holder. Care should be exercised even here, as when the sun is shining directly upon the objective enough light may enter between the card and objective to spoil the negative. Of course no light must enter at the point where the draw-tube and camera are connected. But with an oil-immersion lens a different arrangement must be made, and I have found that a cardboard shutter in the end of the camera-cone, just in front of the end of the draw-tube where they are united, is very convenient.

We have been supposing, in the above description, that sunlight is to be used in our work, but if lamplight is to be used any convenient shade may be placed between the lamp and the condenser.

Let us now describe the several steps in taking a photomicrograph. We will first light the ruby lantern, enter the dark room, shut the door, unwrap a package of negatives, and, selecting one, we insert it, film side up, in the plate-holder. It should be carefully dusted with the broad camel's-hair brush and the slide inserted. With everything in readiness, with due attention paid to the lighting of a good microscopical object and perfect focusing of the image upon the ground glass, with the heat intercepter in place, and the shutter or cardboard properly arranged, we draw the slide from the plate-holder and make the exposure. How long shall it be? This is a perplexing question, because so much depends upon the plates we are using,

the object we are photographing, the objective in the experiment, and upon the illumination.

I would advise every one to keep a record of each and every trial, and be content if at first one good scientific negative is secured out of every half dozen used. I can do no better in answering the above question than to present the results of my experience gathered from a record like the one just recommended.

By using the camera I have described and with Carbutts' 4 x 5 keystone, blue label, lightning plates, the good results with the several objectives described below are given:

WITHOUT CONDENSER.

Leitz, No. 1, in sunlight, ½ second; in lamplight, 5 seconds.

B. &. L., professional, three-fourths, in sunlight, 4 seconds; in lamplight, 20 seconds.

B. & L., student, one-half, in sunlight, 6 seconds; in lamplight, 30 seconds.

WITH CONDENSER.

B. & L., professional, one-fifth, in sunlight, 5 seconds; in lamplight, 1½ minutes.

Leitz, No. 7, in sunlight, 10 seconds; in lamplight, 3 minutes.

Queen & Co., one-fifteenth, N. A. 1.30, in sunlight, 30 seconds; in lamplight, 10 minutes.

The lamplight negatives were all taken with the Acme lamp, using the bull's eye attached to the shade, and placed from eight to fourteen inches from the object, the mirror, of course, being turned aside.

The objects used in the above experiments were various, but consisted mostly of sections of animal and vegetable tissue, parts of insects, diatoms, blood corpuscles, bacteria, and the like.

After making the exposure the negative must be developed, and with every dozen, or half dozen, plates there are printed directions, which it is best to follow closely. The different manufacturers have formulæ which differ in some minor points, but these formulæ are best adapted to the several plates used.

Two principal developers are recommended, known as the *pyro* and *hydrochinon*. Equally good results may be obtained from the use of either of these, if the proper exposure has been made. The pyro develops quicker than the hydrochinon, but the latter can be used over and over again, while the pyro needs to be fresh. Personally, I have had the best results in photomicrography by using hydrochinon, and I would advise every one to try it. There is no danger of over-developing or fogging the picture, and it does not need to be so closely watched as the pyro developer. If a negative is suspected to have been over-

timed it can safely be started with the developer which has been used several times, and has thus become somewhat weakened.

We will now proceed to describe the several steps in developing the picture, using the hydrochinon developer.

The negative is removed from the plate-holder by the light of our ruby lantern only. A sufficient amount of the developer is poured over it in a small tray to cover the negative to the depth of about one-fourth inch. The tray should be rocked back and forth pretty constantly, and the image watched for its appearance. If the proper time has been given to it, the image will begin to appear in about three to five minutes (much sooner with pyro developer), and continue to develop until the details are all to be seen. If at this time we hold the negative up so that we may look through it, the picture will appear quite thin, and as the next bath fades it still more, were it now fixed we should have a very thin negative to print from. So we will return it to the hydrochinon bath, and leave it there until the image has apparently sunk quite out of sight or until upon close inspection in the tray only a faint outline of the high-lights is to be seen, then pour off the developer for future use, and after washing the negative several times in running water it is placed in the *hypo* bath or fixing solution.

At this time we may put another negative in the plate-holder and leave the dark room for a short time. Allow the negative to remain in the fixing bath for one or two minutes after it has cleared and then place in running water for an hour or in a pail of water for four or five hours, changing the water two or three times. It is then to be stood upon end and allowed to drain, becoming perfectly dry, when it may be flowed with varnish before we attempt to print from it.

I have used the sensitized albumen paper and toned the pictures with gold chloride, but the method, although producing excellent pictures, is somewhat lengthy and troublesome.

Many operators, not caring to go through with the process, send their negatives away for the printing and finishing of the picture. So for simplicity and good results I would recommend the Omega paper and Omega toning solution. With these any one can finish a fair picture in a short time and thus know the result of his labor immediately. Specify the size of negative in ordering and thus save the bother of cutting the paper. A one-pint bottle of the solution will tone and fix many prints, and the solution may be used over and over again until exhausted. The directions for printing and using the solution accompany the packages, so that it is not necessary for me to give them here.

I have refrained from giving formulæ for all of this work because the formulæ which I have found printed in works upon photography I have not followed, but I have used those only that

accompany the plates and other packages which I have purchased, and with the best of results.

Exposed to sunlight in a proper printing-frame, the film side of the negative in juxtaposition to the sensitive side of the paper, the latter soon becomes impressed by the negative, and when the print is a little darker than desired it is removed to a tray, where the Omega solution is poured over it. This both tones and fixes it. The print is next washed in water from one to three or four hours and the picture side is squeezed upon a polished sheet of hard rubber or a sheet of ferrotype plate and allowed to dry thoroughly, when it will fall off, leaving a beautiful glaze surface. It may now be trimmed and mounted upon cardboard if desired.

NEW APPARATUS FOR THE MICROSCOPE WHICH IS CHEAP, EFFICIENT, AND HOME-MADE.

By Arthur M. Edwards, M. D.,

NEWARK, N. J.

I am strongly in favor of cheap and efficient apparatus for the microscope, and when it is made by the microscopist himself it is doubly to be commended. The beginners, and for that matter some of the older microscopists, are not blessed with long pockets; and even if they were, economy is to be commended. I can remember the time, not so long ago, when I looked in the illustrated catalogue of some maker of microscopes and envied the possessor of some illuminator or lamp figured there. "Could they be made at home?" I thought. Objectives and oculars must of course be made in the shops, by expert opticians, but illuminators and lamps could be made by any one of ordinary capacity and some manual skill. I do not consider myself to be very skilful, but I do think I can try. Illuminators were the first things I made, and a half-inch plano-convex lens, costing not more than twenty-five cents, was the first. I described that in the *Quarterly Journal of Microscopy* for 1857, and it is efficient still with dry objectives, and even with immersion objectives.

I wish to describe an attachment to the lamp now, or rather a way of modifying the light of the lamp so as to use it with low powers and to render it actinic for high powers. In the *Microscope*, vol. xii, page 237, W. D. Grier mentions a cheap microscope lamp which is very good as far as it goes, and costs $2.15, but I think I can improve on it in the way of cost, and perhaps have it quite as good in quality. The lamp I have used cost 15 cents. I surround it almost with a roll of drawing-paper, but this can be done away with by using cheap white paper. If this

is thick it will stay rolled and you have an excellent shade which, by being white, reflects the light much better than a mirror. To make the modifier, I use a slide 3 inches by 1 inch, of ground glass, and this can be gotten very cheaply. If it is not ground fine enough it can be rendered more finely ground, and, in fact, I think it well to do so, by wetting always with glycerin, or it can be varnished with copal or other white varnish. I also coat another slide of ground glass with a varnish, copal or other white varnish, colored blue. It is colored with blue dye such as is sold for ten cents at the apothecaries. This is all. The lamp and the modifier do not cost 25 cents. That is cheap enough and I know it is efficient.

I now will describe a contrivance for centring and mounting microscopic objects. A brass slide is made of "brass rule" such as printers use for type. It is an inch wide, for that is the height of type and the width of the slide also. Cut it three inches long. The thickness does not matter much, but if as thick as a glass slide it will do. This has ruled on it with a steel point (the point of a file will do) two lines from corner to corner, cutting each other at the centre. This is the place where the cover is placed and this is, of course, immediately in the centre of the slide. An "American clothes-peg" is used to hold it over the source of heat. A slide is placed on the brass slip and is fixed there by the clothes-peg. It is then heated, and the brass, being a good conductor of heat, conveys all the heat over the whole slide, and we run no risk of breaking it. When it is heated enough with the object on the slide a drop of gum thus, which is the medium I use entirely, is placed on it. The alcohol is boiled off and the cover put in place. With this mounting apparatus we do away with the risk of overheating and so of breaking the slide, and as it retains the heat for some time the mounted object can be arranged very nicely. I use this little contrivance very commonly, and I hope that it will meet the wants of microscopists who mount objects themselves.

The cost of slides and covers is high. They can be made of a substance much cheaper, and possess properties which glass has not. In using celluloid, which is wood rendered soluble in ether and alcohol with gum camphor, for films for microphotography I was struck with some of its properties. It is transparent, unbreakable, light weight, and occupies very little room. It is strong as wood, has no fibre, and can be cut readily with scissors. It can be obtained with a ground surface as well as plain, and the cost is a trifle. Very thin celluloid films are used for instantaneous photographs, and this can be employed for both, whilst the thicker kind used for ordinary photography makes capital slides. I have some an inch square which I use in this way, mounting it temporarily in a glass slide for use on the microscope.

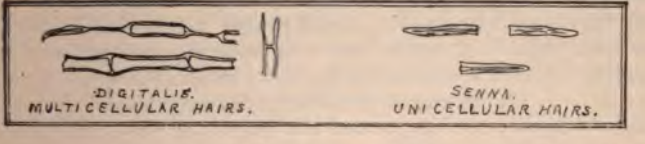
THE MICROSCOPE IN PHARMACY.—I.

By Prof. L. E. Sayre,

LAWRENCE, KANS.

It has been but a comparatively few years since the microscope was considered not much more than an expensive luxury or a mere toy. A few scientists who were peering into the invisible things of nature (whose work few could comprehend) were using it intelligently, but outside of this range of scientific workers few understood its value. What a debt we owe to the men of science who study it for its own sake, regardless of its practical applications! The microscope is an outgrowth of the scientific study of nature, and when we apply it in practice we are constantly reminded of the debt we owe the men of pure science for its existence.

We read a great deal to-day in current medical and pharmaceutical literature of the microscope in pharmacy, and this, however limited, is a sphere of usefulness and of much importance to the public. The pharmacist, if he be well informed as to all the recent methods of investigation, of the means of protection to himself and the public against adulterations, must know the value of this physical instrument. A branch of microscopic research especially interesting to pharmacists is the examination of powders.



Many drugs when reduced to a fine state of division lose all their physical characteristics and become unrecognizable to the ordinary vision. The microscope here proves a valuable assistant in the detection of the true nature of the object under investigation.

As an example of this, the cases of senna and digitalis might be mentioned. These two drugs in the powdered state resemble each other so closely that an ordinary examination reveals no appreciable difference in their appearance. Serious results have occurred from accidental substitution one for the other. But if they be subjected to microscopical examination, elements of difference may be easily discovered. Perhaps the best point of distinction is the hairs occurring upon the leaves. If a sample of powdered digitalis be appropriately mounted on a slide and examined under a one-fifth objective, numerous fragments of hairs will be found mixed with the debris. These, it will be noticed, are *multicellular*. Under the same conditions senna, on the contrary, exhibits *unicellular* hairs. Here, then, we have a ready,

convenient, and accurate method for establishing the identity of these powders.

This is but one example of numerous cases wherein the microscope would prove a valuable assistant to the pharmacist in his daily work, and he who has not the aid of a good microscope stands seriously in his own light.

Within the past few weeks I have had occasion to examine the market supply of buckwheat flour in the State of Kansas. The result of my investigations will be found in the report of the State board of agriculture. It is gratifying to know that there appears to be no mineral (earthy) adulterations in the flour. A microscopic examination reveals the fact that the two principal admixtures are wheat and corn flour, the former often in small proportion. In one case the flour examined contained so little buckwheat that the characteristic starch granules of that grain were scarcely visible. It appeared to be a mixture of corn and wheat flour, containing a small quantity of buckwheat.

MOUNTING LEAVES AND FLOWERS ENTIRE.

By NORMAN N. MASON,

PROVIDENCE, R. I.

In your issue of December, 1892, in reply to question No. 122, "Can leaves and flowers of small plants be mounted entire and show cells, &c.?" I notice that you have given a process which is exactly the one I was following with miserable want of success when Dr. J. G. Hunt, of Philadelphia, helped me out of my trouble by kindly sending to me the following very clear method:

"Soak your leaf or other colored parts of plants in alcohol to remove the chlorophyl, which is soluble in alcohol. If you do not soak too long you may retain and reveal all cell contents and granules. Then wash is water, and bleach in Labarraque's solution of chlorinated soda; chlorinated zinc is as good. When *white*, but *not corroded*, wash thoroughly with water till the soda is removed. *Don't use acid to neutralize.* Then immerse in potash alum solution; strength not important. The alum solution hardens the tissues and acts as a mordant for the color. Let them remain in the alum for two or three hours, then rinse in water. Now you are ready for staining. I prefer double tinting for some things.

"Take extract of logwood (hæmatoxylin) and potash alum, equal parts; pour on a little water and triturate thoroughly until a saturated violet-colored liquid results, and filter; do not add alcohol, for alcohol precipitates, as you will see presently. Take of this violet liquid one-half and glycerin one-half and mix them. This will keep and is the coloring fluid for best hæmatoxylin

staining vegetable tissues. But in this condition it is too strong for use; dilute until the specimen may be seen when immersed, and in a white dish. *Give ample time* for staining; here is the secret.

"Take next, or first if you like, aniline blue, and mix in water; strength not important. Make a solution of picric acid in alcohol, add a few drops of the picric acid solution to the solution of aniline blue until you develop a chlorophyl green; now soak in this liquid *a few hours, or a day*; perhaps it will stain some parts which hæmatoxylin will not—growing points, spores, crystoleths, stomata, etc. It is sometimes best to stain first in the green, then in the violet. Never allow your specimens to dry, and absolute alcohol is not needed. Now immerse in 95 per cent. alcohol to dehydrate. Alcohol precipitates the hæmatoxylin in the tissues, and extracts the excess of picric acid, and fixes a beautiful blue-green color just where nature likes it best, while the alum prevents structural change in the most delicate parts. You may keep specimens for weeks in this watery alcohol, and every cell wall will become more distinct until you find time to mount.

"Clarify the specimen in oil of cloves, thoroughly drain off all the superfluous oil of cloves (I lay the specimen on my hand; that soaks it up), then mount in Canada balsam."

I do not know how thick a leaf must be to be too thick to show clearly through the leaf the cells on the underside, but a mullen (*Thapsus verbascum*) will show each layer from the hairs on the top to the tips of the hairs on the underside *as clearly as if the cells were made of spun glass.*

Staining Vegetable Sections.—Having cut thin sections of any plant or stem, the specimen may be rendered more intelligible by staining it before mounting. Different dyes stain different parts of the structure and so make these parts seem more prominent. The contents of cells are also brought to view in this manner.

There are three kinds of effects produced by stains: (1) Some stains attack the nuclei and are called nuclear stains. These leave all but the nuclei uncolored. Hæmatoxylin and carmine are prominent nuclear stains. (2) Some stains color the ground substance and leave the nuclei uncolored, or color all the tissue uniformly. These are called plasmatic stains. The contrasts produced by coloring nuclei with carmine and the ground tissue with a stain, such as eosin, is very striking. (3) Specific stains color certain elements of the tissues only. For instance, liquefied tissues are stained with methyl green. Cellulose may be colored blue. Lignin may be colored yellow.

From these principles result double and even triple staining of the same specimens, but the process is tedious.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

What can a Beginner do in Microscopy?—There are a good many young people commencing to take an interest in botany, entomology, geology, ornithology, etc., who spend much time to little profit for lack of suitable guidance, oral or written. And there are teachers who feel too much tied to their text-books and so who cannot practically start their pupils in interesting work. There is an impression abroad that the members of the Agassiz Association lack direction, systematic and continuous application to single topics such as will yield desirable fruit. Collecting plants, insects, rocks, birds' eggs, etc., sometimes is followed by little more than identification.

At this point the microscope may be wisely brought into use, and we shall be happy to tell the young people of the Agassiz Association, as well as others, what to do next and how to do it. Each chapter of the Agassiz Association, if not each individual, ought to afford a $20 outfit in the way of microscope and accessories. If they will each then fix upon some topic such as is named below and pursue it, we shall be glad to provide, free of charge, all needed assistance.

As soon as we can get the illustrations and the descriptions of the instruments (March or April) we will set forth in much detail directions for purchasing an instrument, and will intercede with the dealers for the very lowest prices. You do not want one of the toy microscopes which can be bought for $3, because its powers are too limited, but you need one such as is pictured by several of our advertisers.

The following indispensable features for such a compound instrument have been named by Dr. Shanks in response to a question:

"A compound microscope should have a one-inch or C eyepiece, a joint for inclination. The mirror should swing above the stage so as to furnish a top illumination on opaque objects and a fine adjustment. The rack-and-pinion coarse adjustment is convenient but not necessary, if the cost must be kept low. There should be two object-glasses—a one-inch and a one-quarter inch. The one-inch glass will give good surface views of opaque objects and good general views of sections. The $\frac{1}{4}$-inch glass will magnify sufficiently, and is easier to use than the usual $\frac{1}{5}$-inch or $\frac{1}{6}$-inch objective. These latter glasses work very closely and require thin sections for their full utilization. The $\frac{1}{4}$-inch objective should resolve *P. angulatum*."

Topics for Study.—As to selection of topics for study, we are able to present the views of two different writers, both experts. Additional directions may be found in many books, some of the best and cheapest of which may be found listed among the advertisements. Dr. Shanks' advice is as follows:

"Buy this book: '1000 Objects for the Microscope,' by M. C. Cooke. It will cost 50 cents and will suggest the examination of many common objects to be found everywhere. As a suggestion for some lines of work that young people may do, the following will be within their abilities:

"Study the habits and food-plants of insects, especially those feeding on our vegetables and fruits. The insects may eat the leaves or the fruit, or bore into the bark or wood. Examine all parts of the plant for eggs, worms, or cocoons. Make collections of all of them. Hatch out some of the eggs. Also try to develop the cocoons or pupæ. Make notes of every circumstance, date, plant, etc. Do not try to do too much in one year. Select two or three plants for study. Reliable information in these lines will be gladly received by our State entomologists and botanists, who will cheerfully name any specimens sent them for identification. Make pressed and dried collections of the mosses in fruit. Make notes of the localities when found and date. Gather the catkins, etc., of willows and other trees that bloom early before the leaves appear. Gather the leaves later; then the fruit in early autumn. Put them together. Make notes of the different dates, etc.

"Grasses are easily gathered and easily pressed and dried, and the variety is greater than one would imagine. Make collections of the grasses—when in bloom—and also when the heads or spikes are in full seed. Note also the root, whether it is simply fibrous like an annual, or has an underground fleshy stem like the perennials.

"All collections should be arranged in some orderly manner, and each specimen named as far as possible. The common name will do at first, the proper scientific name to be attached later. Science means systematized knowledge, and its first law is order; so notes and specimens should be kept in some well-thought-out order and improvements made as knowledge of the subject is acquired."

In reply to the same question, Dr. A. C. Stokes writes a list of topics for study as follows:

"Hairs, glands, scales of plants—a field practically unlimited. Scales of insects: how many different forms, how many ways attached, what surface markings. Internal crystals of plants, (raphides, sphæraphides, long-crystal prisms, etc.): what plants contain each kind. The wonderful variety in the cell form in the epidermis of leaves, of petals, and especially of anthers of flowers. (This is good work, and easy with the method which I hit on of boiling in glycerin to make the whole thing transparent.) The different forms of insect antennæ—practically endless. The teeth of the different kind of flies—interesting and practically untouched in this country. The different forms of pollen. Stomata (breathing pores of plants); different forms and differing cell structure (use ¼-inch objective). Teeth of land and of water snails (almost endless variety for ¼-inch). Insect eggs: different forms and markings; for low powers; opaque; endless. The trouble with the Agassiz members is that they spread themselves over too much space, and so accomplish little or nothing. If each member or each chapter would select some subject and investigate that only, even for a limited time, the result would be better. There is no end to the subjects that the beginner could investigate. All he needs is to be started and to stick to some single subject till he becomes an amateur expert in it."

QUESTIONS.

NOTE—*These questions are addressed to all our readers, who are invited to send answers for publication in a subsequent number. In replying, say as much as possible in as few words as possible.*

The Lord's Prayer has been written on glass with a diamond and inside 1-28,oooth of a square inch. What is the process?—L. M.

What known locality is richest in variety of fossil diatoms? What in fresh-water diatoms? What causes determined the quantity of diatoms in any given deposit?—H.

What is the best method of collecting corpuscles from blood stains and then of mounting them?—H. M. F.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

129. How are microtome knives to be kept in sharp condition?—R.

The knife must be carefully honed on a perfectly even and flat oil-stone. The process is similar to that of honing a razor. This sharpening should be done habitually after using the knife, and before it is laid away. The stone should be very fine, and one too hard for a barber's hone, "because it cuts too slowly," is just the sort of a stone to put a very fine, smooth edge on a microtome knife. If the knife has been nicked it should be sent to the cutler to be ground to a smooth, straight edge, and be honed as if it were a razor. A piece of good calfskin glued to a flat wooden back may be used as a strop to keep the edge keen, at intervals during the cutting of sections.

130. How are vegetable sections to be preserved while awaiting opportunity to mount them?—R.

They are best preserved in alcohol, especially if they are to be mounted in balsam. If intended for glycerin or glycerin jelly, preserve them in glycerin and water, equal parts, with a little camphor or carbolic acid added, to prevent mould. Sections preserved in this latter fluid may be mounted in balsam if the glycerin be carefully removed by soaking them in several waters.

131. Will vegetable stains fade out if exposed to sunlight?—R.

Sunlight is a very powerful bleacher, and unnecessary exposure in it should be avoided. Vegetable sections stained in carmine, picro-carmine, or logwood may be regarded as permanent. Sections stained in the aniline dyes are not permanent, as a rule, and will quickly fade in sunlight.

132. In double-staining a section should a light or dark stain be used first?—R.

That depends upon the chemical characteristics of the staining fluid, not upon the hue. Some aniline dyes may be used together, as safranine and methyl green. The following double stains should be used separately and in the order named: carmine and logwood, logwood and eosin, picro-carmine and aniline green or blue, carmine and indigo-carmine. Picro-carmine, rosein and indigo-green, used in this order, will produce a triple staining in suitable objects.

133. Is there any method for tempering the paraffin to the density of a section so that it will cut evenly? If so, what is it?—R.

Paraffin is not usually tempered for this purpose. It is graded to have a certain melting point or hardness, which will cut smoothly at a certain temperature of the surrounding air. If the paraffin proves to be too hard, by crumbling or otherwise, raise the temperature of the air in the room, or reimbed the specimen, using more of the soft wax. A hard paraffin will allow a very thin section to be cut, but it rolls tightly and is very troublesome to flatten. A very soft paraffin does not support the tissue well. It will crowd up or wrinkle or break. A paraffin melting at 125° F. will usually cut well at a temperature of 70° F.

134. What microscope can a beginner get for little money, that will be of some use to him?

For a beginner the Excelsior Microscope, listed at $2.75, can be recommended. This instrument consists of a small oblong box containing a mirror, and a rod which can be erected; also a pocket magnifier with three lenses, and an adjustable stage which will slide upon the rod. The whole forms an easily used, simple microscope. But one cannot do much real work without a compound microscope. The cheapest one that will be at all satisfactory will cost at least $28.00. The so-called "School" or "Household" microscopes, or other such cheap instruments, are worse than none, because their imperfect and misty definition will do much to discourage a student. A microscope, if good, will not only aid study but encourage it.

SCIENCE—GOSSIP.

To Preserve Impressions of Leaves.—Those who desire to preserve impressions of leaves of trees and plants can do so in the following simple manner: At any druggist's get a nickel-worth of bichromate of potash, and put it in a 2-oz. bottle of soft (rain) water. When the water has dissolved as much as it will of the potash, pour off the clear liquid into a shallow dish. On this float a piece of ordinary writing-paper till it is thoroughly saturated. Let the paper be hung on a piece of string in the dark until it gets nearly dry, when it should be in color a bright yellow. On this put the leaf, and under it a piece of black cloth and several sheets of newspaper. Put these between two pieces of clean window-glass of the same size, and hold them together with spring clothes-pins or with spring clips similar to those used for holding letters or bills. Expose to a bright sun, placing the leaf so that the sun's rays will fall upon it as nearly perpendicular as possible. In a few minutes it will begin to turn brown,

but it requires from half an hour to several hours to produce a perfect print. When it has become dark enough, immerse the paper in a dish of clean water, which must be changed every few minutes, until the yellow part becomes perfectly white. The print can then be mounted in a scrap-book.—*Adapted from "Work."*

The Doctor's Microscope.—The microscope has now become an indispensable instrument in medical practice, without which the physician must often work without the knowledge which his patients justly expect him to command.—*Boston Medical and Surgical Journal.*

Oil of Anise-seed as an Imbedding Medium for the Freezing Microtome.—Dr. H. Kühne has discovered that oil of anise-seed may very successfully be used as an imbedding medium for cutting sections with the freezing microtome. The procedure is as follows: Pieces about 2 mm. thick are placed on blotting-paper to remove the alcohol, and then immersed in a capsule containing the anise-seed oil for 12–24 hours. When thoroughly saturated with the oil—and this is easily recognized by the clearing up of the material—the pieces are placed on the microtome and sectioned. The sections are temporarily transferred to anise oil on a glass rod, and when all the piece is sectioned, are placed in alcohol (twice repeated) to remove the oil. When all the oil is removed, the sections are ready for staining.—*Jour. Royal Micr. Soc., Oct., 1892.*

Methylen-blue Staining of Nervous Systems of Invertebrata.—Herr O. Bürger, when investigating the nervous system of Nemertine worms, seems to have obtained very good results, judging at least from the colored illustrations said to be faithful representations, by injecting these animals with a fluid made by dissolving 0.5 grm. methylen-blue in 100 grm. of ½ per cent. cooking salt solution, or with a simple watery solution of the same strength. Sea-water, in which methylen-blue is perfectly soluble, is quite unsuitable for the purpose. The injections were made frequently, one injection imparting only a faint staining. The best period for injecting was in the half-dead condition, or in that state when the animal or parts thereof still show signs of life. The time required for bringing about good injection results was at least 6–8 hours, and sometimes much longer. After a time the author found that satisfactory results were more easily obtained by merely injecting a part or organ. The preparations were fixed with dilute picrate of ammonia and afterwards put up in glycerine to which a trace of ammonia had been added.

The staining does not last very long, and hence in examining a specimen it is advisable to begin at those parts from which the blue color first disappears, viz., at the periphery.—*Mittheil. Zo. Station zu Neapel—1891.*

RECENT PUBLICATIONS.

Le Micrographe Preparateur.—A monthly journal. Vol. 1. No. 1. January, 1893. J. Tempère: Paris.

Our friend Tempère, of Paris, has just commenced a microscopical magazine of the same size as *The Microscope.* As it is published in French, we are sorry to think that but few copies will be taken in the United States. Those microscopists, however, who read French are invited to send to us for a sample copy and to subscribe.

The contents for January are as follows:

1. Editorial announcement, 1 page—the editor.
2. Technique of Preparations, 3pp.—Tempère.
3. Cryptogamic maladies of cultivated plants (I. The grape vine), 5pp.—Dutertre.
4. The genus *Vaucherai*, 2pp.—M. L. Dupray.
5. Adulterations (I. Of pepper), 4pp.—A. Deros.
6. Correspondence, Exchange, etc., 1 page.

The second, third, and fourth articles are illustrated. In all, twelve figures are presented and grouped in one lithographed plate.

Mr. Tempère has granted us permission to translate articles for our Journal, which we shall occasionally do. He speaks and writes remarkably good English himself, and has been much amused by some American translations that have been made of his articles in *Le Diatomiste* during 1891 and 1892.

The price of *Le Micrographe Preparateur* is $3.00 per year. Subscriptions will be received by us at $2.75—club rate.

The Microscopical Examination of Potable Water.—By Geo. W. Rafter. D. Van Nostrand Company, N. Y.: 1892. Price, 50 cents. 16mo, 160pp.

This little hand-book belongs to the Van Nostrand Science Series (No. 103) and is based upon a paper published several months since in the *Microscopical Journal.* There have been added some valuable tables, a diagram, and a classified list of 150 books, journals, and micellaneous papers bearing upon the subject. The 19 classes are as follows: Water in its chemical, biological, and sanitary relations (51 titles); general botany (3); cryptogamic botany (2); fresh-water algæ (5); desmids (3); diatoms (5); fungi (6); general zoölogy (3); microscopical crustacea (3); rotifers (2); polyzoa (3); infusoria (3); rhizopods (1); sponges (4); general physics (3); light and its relations (3); optics (5); the microscope and microscopical technology (25); miscellaneous, biology, etc. (20).

THE MICROSCOPE.

MARCH,

1893.

NUMBER 3. (NEW SERIES.)

AMERICAN SOCIETIES INTERESTED IN MICROSCOPY.—II.

BY CHAS. W. SMILEY,

WASHINGTON, D. C.

(Continued from page 11.)

Since publishing the provisional list in January some very interesting facts have come to light, but from many societies nothing has been heard. Mr. Geo. Otis Mitchell, of San Francisco, has placed at our disposal all the information that has been collected by the San Francisco Microscopical Society. Much of it is incorporated in this article.

The inquiry has revealed the fact that 15 societies have ceased to exist, or at least suspended action indefinitely. The list is as follows, and we desire that those who know the facts will inform us when these societies discontinued holding meetings, and for what reasons.

LIST OF FIFTEEN SOCIETIES REPORTED DEAD.

California.—California Microscopical Society, Girls' High School, San Francisco, Cal.

Indiana.—Indianapolis Microscopical Society, Indianapolis, Ind.

Maine.—Portland Microscopical Society, Portland, Me.

Maryland.—Baltimore Microscopical Association, Baltimore, Md.

Massachusetts.—Boston Microscopical Society, Boston, Mass. (Became a section of the Boston Society of Natural History.)

Wellesley Microscopical Society, Wellesley, Mass.

Michigan.—Griffith Microscopical Society, Detroit, Mich.

Minnesota.—Minneapolis Microscopical Society, Minneapolis, Minn.

New Jersey.—Camden Microscopical Society, Camden, N. J.

New York.—Dunkirk Microscopical Society, Dunkirk, N. Y. Jamestown Microscopical Society, Jamestown, N. Y. Amer-

ican Microscopical Society, New York city. Rochester Microscopical Society, Rochester, N. Y. (Absorbed by the Rochester Academy of Sciences.)

Pennsylvania.—Bethlehem Microscopical Society, Bethlehem, Pa.

Rhode Island.—Providence Franklin Society, Providence, R. I.

Of these 15 societies, 4 were reported in our list on page 10. The others have been added to show the remarkable decrease in societies during the past few years. Out of a total of 70 societies thus far discovered, 15 have died within 3 or 4 years.

List of Eight Societies Reported Additionally to the List of Fifty on pp. 10–11.

Illinois.—Microscopical Section, Chicago Academy of Science, Chicago, Ill. (Same as the Illinois State Microscopical Society.)

Iowa.—Council Bluffs Microscopical Society, Council Bluffs, Iowa.

Michigan.—Michigan Teachers' Society of Microscopists, Ypsilanti, Mich.

New York.—Canandaigua Microscopical Society, Canandaigua, N. Y.

Ohio.—Tyndall Association, Columbus, Ohio, C. C. Howard, M. D., Secretary. Ohio State Microscopical Society, Columbus, Ohio.

Pennsylvania.—Erie Microscopical Society, Erie, Pa., Rev. Geo. Goetz, Sec'y.

Tennessee.—Memphis Microscopical Society, Memphis, Tenn.

Texas.—Austin Microscopical Society, Austin, Texas, Dr. T. J. Bennett, Sec'y.

The following information has been furnished by the secretaries of the different societies, and a considerable part of it had been collected by Mr. Mitchell before the publication of our provisional list of societies.

Many other societies, yet to be heard from, are earnestly invited to reply to the following questions:

1. In what year was the society organized?
2. In what year incorporated (if at all)?
3. Has it printed copies of its constitution for distribution?
4. What is the regular time for meetings?
5. How many members (specify active, honorary, etc.) has it?
6. What are the membership fees?
7. What microscopes and accessories does it own?
8. About how many mounts has it?

9. How many books, pamphlets, etc.? (Specify the most important.)

10. What is the average attendance at meetings?

11. How is an account of the meetings published?

12. Who are the president, secretary, and treasurer for 1893?

13. Add any other items of general interest.

United States.—American Microscopical Society. (National.)

Organized at Indianapolis, 1879. Incorporated, Washington, D. C., 1891. Constitution printed in proceedings. Meets annually in August. Average attendance, 30. Number of members, 381 in 1891. Annual dues, $2.00. Has published 13 annual reports. Owns no books nor instruments.

President, Prof. J. D. Cox, Cincinnati, Ohio; Vice-President, Dr. Geo. M. Sternberg, U. S. A.; Vice-President, Dr. A. Clifford Mercer, Syracuse, N. Y.; Secretary, Dr. Wm. H. Seaman, 1423 11th street, Washington; Treasurer, C. C. Meller, Pittsburg, Pa.

United States.—American Postal Microscopical Club. (National.)

Organized 1875. Not incorporated. Constitution not in print. No meetings are held. Membership, about 140 (list published). Publishes a report annually. Dues, $1 per year. No property, books, microscopes, etc.

President, Prof. Samuel Lockwood, Freehold, N. J.; Secretary, S. G. Shanks, M. D., 547 Clifton ave., Albany; Manager, R. H. Ward, M. D., Troy, N. Y.

California.—San Francisco Microscopical Society.

Organized June 4, 1870. Incorporated Aug. 30, 1872. Annual meeting, 1st Wednesday in February. Meetings, 1st and 3d Wednesdays at 432 Montgomery st., 8 P. M. Initiation, $20. Monthly dues, $1. Regular members, 60; life, 8; honorary, 8; corresponding, 27.

Library of about 1,000 bound volumes. and 100 pamphlets. Cabinet of nearly 5,000 slides. Reports of meetings have been published in local papers and in *Microscopical Journal.* Is commencing to publish Journal of the S. F. M. S. Owns large Beck stand, large Zeiss stand, large Nachet stand, several mounting and dissecting stands, Zeiss photomicrographic apparatus, Yung's large microtome, bacteriological apparatus, etc., etc.

A very extensive collection of diatomaceous earths from all over the world.

President, A. H. Breckenfeld, 1 and 3 Samson St.; Vice-President, Dr. Douglass W. Montgomery, 1124 Sutter street; Recording Secretary, Wm. H. Loy, 423 Clay St.; Corresponding Secretary, George Otis Mitchell, 1034 Pine St.; Treasurer, C. C. Reidy, 432 Montgomery St.

Colorado.—Denver Microscopical Society.

Organized 1883. Incorporated 1888. Membership, 18. Meetings, 2d and 4th Mondays. Library of 500 vols.

President, Prof. H. F. Wegener; Vice-President, W. Edmundson, M. D.; Secretary and Treasurer, J. B. Kinley, M. D.

Illinois.—State Microscopical Society of Illinois, Chicago.

Has become a section of the Chicago Academy of Sciences, retaining its own name and charter and articles of incorporation. Organized April 23, 1868. Incorporated March 31, 1869. Has printed constitution. Meets the 2d Friday of each month, from October to May. Has 120 active members. The section has no dues and no expenses. Each member, however, pays $5 per annum for membership in the Academy. The section owns considerable apparatus. The average attendance is from 30 to 40 The proceedings are published in the records of the Academy of Sciences. The section has been assigned 360 feet of space at the World's Fair for the purpose of making an exhibit. Activepreparations are going on. Chairman of section, H. L. Tolman; Recording Secretary, Prof. F. L. Morse; Treasurer, Wm. H. Summers, 3450 Cottage Grove avenue; Corresponding Secretary, C. O. Bering; Vice-Presidents, B. F. Quimby, D. W. Chapman.

Kansas.—Sphinx Society, Atchison.

There is some question regarding the propriety of classifying this society as microscopical, although a large number of its members are interested in microscopy and frequently read papers bearing on the subject. From 1889 to 1891 there existed at Atchison a purely microscopical society, that gradually merged into the Sphinx. The latter was organized in November, 1890, and is not incorporated. It has no printed constitution. It meets fortnightly, on Thursday evenings, from October to June. Average attendance, 10; number of members, 22 active, 3 honorary. Dues 50 cents on entrance, and assessments as required. No apparatus, mounts, nor books. No account of meetings published. President, A. H. Lanphear, M. D.; Secretary and Treasurer, E. B. Knerr, Sc. D.

Kansas.—The Kansas Pharmaceutical Society contemplates organizing a microscopical section with the view to maintaining a State organization for microscopy. L. Ardery, Hutchinson, Kansas, is said to be Secretary.

Michigan.—Michigan Teachers' Society of Microscopists, Ypsilanti.

Organized June 22, 1891. Not incorporated. Constitution hectographed. Meetings held annually during commencement week of Michigan State Normal School; average attendance, 12. Meetings reported in the *Naturalist Teacher*. Membership, about 15; annual dues, 25 cents. No apparatus, mounts, nor books.

President, C. D. McLouth, Muskegon; 1st Vice-President, W. F. Lewis, Ypsilanti; 2d Vice-President, J. Q. Roode, Hanover; Secretary, F. E. Andrews, Ypsilanti; Treasurer, M. W. Wimer, Mt. Pleasant.

"The object of this society is to encourage the use of the microscope in the public schools."

The society exists mostly on paper. A great obstacle to progress is the fact that members do not own microscopes. Being teachers, their microscopes are things of the future, which will probably never come to most of them. Society was originally organized from a class (the first taking that work) in "biological training," Michigan State Normal School.

Missouri.—St. Louis Club of Microscopists.

Organized May 7, 1887. Not incorporated; 21 members; meetings, 2d Monday, at College of Pharmacy, 2108 Lucas Place. Library, 25 bound volumes of journals. Cabinet, 200 slides, principally drugs. Chief aim is the advancement of microscopy as applied to pharmacy and the allied sciences among pharmacists.

President, J. C. Falk, M. D.; Vice-President, Thos. A. Buckland; Secretary, S. E. Barber; Treasurer, H. M. Whelpley, M. D.

Nebraska.—Lincoln Microscopical Club.

Organized January 25, 1872. Not incorporated. No printed constitution. Meetings, last Tuesday of each month. Average attendance, 15; 26 active, 1 honorary, 2 non-resident members. Dues, $1 per annum. Meetings reported in *American Microscopical Journal.* No apparatus, mounts, nor books. Those belonging to the University of Nebraska are available to the members. President, A. F. Woods, Botanical Laboratory, University of Nebraska; Secretary, Roscoe Pound, Burr Block; Treasurer, J. S. Dales.

Nebraska.—Omaha Microscopical Society.

Organized March 17, 1892. Not incorporated. Members, 20. Formerly met weekly, now rarely. Meetings reported in Omaha *Clinic.* No apparatus, mounts, nor books.

President, Irvin Leviston; Secretary, Geo. Wilkinson, M. D.

New York.—Brooklyn Microscopical Society.

A department of the Brooklyn Institute of Arts and Sciences; made a department in 1888. Meetings, 1st Monday of each month; membership, 133. Institute publishes Year Book.

President, S. E. Stiles, M. D.; Vice-President, J. W. Freckelton; Secretary, Geo. E. Ashby; Treasurer, Edward C. Chapman.

New York.—Nyack Society of Microscopists, Nyack-on-Hudson.

Organized, May, 1891, with 7 members. Membership, 14. Meetings, 1st Wednesday. Cabinet, 170 slides. Library started.

Officers: President, Dr. G. F. Blauvelt; Vice-President, Frank Prevost, Esq.; Recording Secretary, Miss C. M. Whitaker; Corresponding Secretary, J. C. Gregory; Curator, Prof. Ira Lawton.

New York.—Canandaigua Microscopical Society.

Organized and incorporated June 8, 1880, with 11 charter members, 25 active and 7 honorary members (8 ladies). Meetings, 2d Tuesday in each month except July and August.

President, Rev. N. M. Calhoun; Vice-President, Prof. E. H. Eaton; Secretary and Treasurer, Dr. Charles T. Mitchell.

New York.—Microscopical Section of Troy Scientific Association, Troy, N. Y.

Organized 1870. Incorporated 1874. No printed constitution. Meets 1st Monday of each month. About 70 active members of the association. Dues $2 per year. No instruments, mounts, nor books to mention. No reports published.

President, R. H. Ward, M. D.; Corresponding Secretary, Geo. H. Ennis; Treasurer, Joseph McKay.

Ohio.—Ohio State Microscopical Society, Columbus, O.

Organized Oct. 11, 1887. Not incorporated. No printed constitution. Meetings, the last Friday of each month, except July and August. Average attendance, 12. Active members, 25. Dues, $1 per annum. No instruments, mounts, nor books. Reports published in local papers.

President, O. Frankenberg; Secretary and Treasurer, A. Feiel; Trustees, H. A. Weber, H. J. Detmers, Dr. C. R. Vanderburg.

Pennsylvania.—Iron City Microscopical Society, Pittsburg.

Membership, 91. Initiation, $2. Dues per year, $3. Library, about 400 vols.

President, Dr. T. L. Hazzard, Alleghany; Vice-Presidents, Prof. J. Tingley, Alleghany; Dr. C. Q. Jackson; Recording Secretary, Dr. Hiram Depuy; Corresponding Secretary, J. F. Henrici; Treasurer, Jas. A. Moore.

Pennsylvania.—Philadelphia Academy of Sciences.

Biological and Microscopical Section organized March 30, 1858.

Texas.—Austin Microscopical Society, Austin.

President, Dr. J. W. McLaughlin; Secretary, Dr. T. J. Bennett.

Canada.—Microscopial Section of the Entomological Society of Ontario.

Section organized November 15, 1890. Not incorporated, but the society was incorporated in 1870. Constitution not printed. Section meetings, 1st and 3d Fridays of each month. Active members, 13. Dues, $1 for membership in the Entomological Society.

The society owns 2 microscopes: (1) a Carpenter & Westley monocular, with polariscope, 4 objectives, 1 eyepiece: (2) a Zentmayer binocular, with 6 objectives, 5 eyepieces, a double nose-piece, parabolic reflector, polariscope, camera lucida, turn-table, frog-plate, live-boxes, condensing lenses, etc. The society owns 171 mounts and 23 microscopical books, including Beale, Carpenter and Micrographic Dictionary.

The proceedings of the society are published in an annual report at the government's expense.

Leader of section, John Bearness, professor of zoölogy in Western University; Secretary, H. A. Stevenson; Treasurer (of the society), J. Blackwell. Each section presents a report to the society at its annual meeting. The sections use the library rooms, etc., of the society, and the members have all the privileges of the society on payment of the fee. The rooms are always open. The society has fine collections of insects and publishes the *Canadain Entomologist*. The library contains 1,214 volumes and many pamphlets. Besides the Microscopical Section, there are sections in Ornithology, Botany and Geology.

THE MICROSCOPE IN PUBLIC SCHOOLS.

By Wm. W. WEIR,

SOUTH FRANKFORT, MICH.

[From The Naturalist Teacher.]

I am using a microscope in my school. I have a regular hour set apart when each pupil comes to the glass and makes his observation, passes quietly to his seat, and the next comes, and so on till all have made an observation. From the outset great interest has been manifest. A great majority are enthusiastic. During the noon and recess hour there is a throng at my desk seeking admission to the glass.

In the higher grades, I use the glass mostly for technical purposes. In the lower grades, the main purpose is to please—but even here I find appreciation. It is amusing to see the primary children crowd around the table exultant with joy, when the glass goes to their room. I believe that there is more disciplining power in the microscope than in iron-clad rules or rods. Bring the microscope into a room where all is confusion, and instantly the scene is changed.

I have not met with any opposition from patrons. Should such a thing come in the way of the free use of the microscope, I would hold a public microscopical entertainment, inviting the general public, giving them a genuine demonstrationiof the use and utility of microscopical work.

Before using the microscope, I used a strong Coddington lens with good success. Plant tissue can be very well appreciated with a good lens, also the various parts of insects; and it leads up to the demand for a better glass. Long before I began using the microscope, my pupils proposed getting up socials and entertainments for the purpose of purchasing a glass for the school. The time is not distant when every graded school in the State will have the microscope as a part of its needed apparatus.

BACTERIA IN ICE.

By M. Noll,

ATCHISON, KANS.

[Abstract of a paper read before the Sphinx Society, and reported by E. B. Knerr, Secretary.]

Impurities may occur in even the best of ice. Samples obtained from the Missouri river, the lakes and creeks in the neighborhood of Atchison, and from the Atchison city reservoir were subjected to chemical and biological analysis. In all, more or less organic substance was found, especially in that from the creeks. But the biological examination is of especial interest to those interested in microscopy. It is commonly supposed that life in ice is impossible, but in all specimens examined life was found at least in the dormant or spore condition. Fragments taken from the centres of large blocks of ice were carefully washed with sterilized and distilled water and quickly placed into sterilized tubes containing nutrient gelatin. So rapidly did the bacteria multiply that in three days they became visible as a hazy cloud near the surface. In a few more days the gelatin was liquefied and full of them. Check tubes of the same solutions, prepared at the same time and under the same conditions, but without the addition of ice, presented no bacterial growth whatever, even after the lapse of a month. Plate cultures were also made, and from the colonies thus developed several different species of bacteria were isolated. It was thought, however, that none were of a harmful nature. Ice from the creeks gave the greatest variety of growth, while that from the Missouri river showed the least variety.

Poisons.—Have a special closet for all poisons and do not let people have access thereto indiscriminately. Have all the packages properly labelled, but, to prevent involuntary accidents, keep them in no particular order and never put the same package twice in the same place.

A PNEUMATIC BUBBLE REMOVER.

By A. P. Weaver,

JACKSON, MISS.

Being annoyed with air bubbles in my mounts, I have made a simple air-pump for removing them, as follows: Take a small rubber syringe, the packing on the cylinder of which ought to be adjustable so as to fit the body of the syringe rather tightly; cut off the nozzle rather close to the body, and bore a hole 3 *mm.* in diameter near the top of the latter, so that the packing will always be below the hole. Cut from an old rubber boot two washers 2.5 *c.m.* in diameter and with a central aperture of 2 *c.m.*; cement these washers together with Red Cross cement (such as is used for mending punctures in pneumatic bicycle tires); cut from the boot two more washers of the same outside diameter and with a central hole a little smaller than the nozzle of the syringe; cement these last two washers together also, and cement them to the first two prepared; you will now have a shallow chamber a little larger than the cover-glass. Force the nozzle of the syringe through the opening in the two top plates and firmly cement it there. All these joints must be air-tight.

To use the instrument, place the slide on a smooth surface, wet the under surface of the rubber washers and apply the same to the slide with the cover-glass in the shallow chamber. To make a good air-tight contact with the slide, grasp the syringe with the left hand and allow the lower side of the latter to hold the washers firmly to the slide. The hole drilled in the syringe is to act as a trap or valve and is to be tightly covered with the first finger of the left hand (keeping the latter in position, grasping the syringe and holding the washers to the slide) at each downward stroke of the piston and uncovered at each upward stroke. This is, of course, done to prevent the entrance of air to the vacuum chamber beneath, after it has once been exhausted. I have found that three or four strokes are sufficient to bring all bubbles to the surface of the mounting fluid and cause them to burst.

MICROSCOPE EYEPIECES.

By O. Beckerlegge.

There is this difference between the eyepiece of a telescope and microscope: on a telescope a much higher power can be used than on a microscope. In the former a long focus object-glass is used; consequently the image is not magnified to any great extent: the main magnification is made by the eyepiece. In the microscope the object-glass is of short focus, and consequently magni-

fies the object in proportion. For example, suppose normal sight is 10 in.; then, if we use a lens which has a focal length of 5 in., the eye is brought twice as near to the object, and consequently the object will appear twice as large; or if we use a lens $2\frac{1}{2}$ in., then the diameter will be magnified four times, and so on, up to $\frac{1}{2}$ an inch or other higher power. Of course a high-power eyepiece could be used on any object-glass. But there is this drawback: in all object-glasses of high power, except those of the highest possible quality, there will be some little defect, and to use a high-power eyepiece would be to magnify the image of the object, defects and all. Thus, from the construction of the instruments, a much higher power eyepiece can be used on the one than on the other.

Eyepieces for the microscope are sometimes designated A, B, C, D, etc. They consist of two lenses: a large one nearest the object-glass, called the field lens, and a small one nearest the eye, called the eye lens.

A general rule for diameters is that the field lens should be twice that of the eye lens; thus, if the field lens is 1 in. in diameter, the eye lens should be about $\frac{1}{2}$ in. in diameter. The rule for local length is that they should be as 2 to 1; thus, if the field lens is $1\frac{1}{2}$ in., then the eye lens must be $\frac{3}{4}$ in. These are placed with their plane side towards the eye, and one-half of their combined focal length apart; thus $1\frac{1}{2} + \frac{3}{4} = 2\frac{1}{4} \div 2 = 1\frac{1}{8}$, so that they would be $1\frac{1}{8}$ in. apart. A stop must be placed between these at the focus of the eye lens, the opening the same as its diameter.

To determine the focal length of the eyepiece, proceed as follows: Multiply the focal length of the lenses into each other and then by 2, and divide the product by the focal lengths when added together; thus $1\frac{1}{2} \times \frac{1}{2} \times 2 = 1\frac{1}{2} : 1\frac{1}{2} + \frac{1}{2} = 2 : 1\frac{1}{2} \div 2 = \frac{3}{4}$, so that the eyepiece constructed by these lenses would be $\frac{3}{4}$-in. focal length.

The following are given by a manufacturing optician:

1. Eye lens, $1\frac{1}{2}$; field lens, 3; distance apart, $2\frac{1}{4}$.
2. Eye lens, 1; field lens, 2; distance apart, $1\frac{1}{2}$.
3. Eye lens, $\frac{3}{4}$; field lens, $1\frac{1}{2}$; distance apart, $1\frac{1}{8}$.
4. Eye lens, $\frac{1}{2}$; field lens, 1; distance apart, $\frac{3}{4}$.

In making eyepieces for the telescope, the relative focal length of field lens to eye lens is 3 to 1. In mounting the lenses in their cells, the plan already given should be followed. With these principles, any clever worker in brass should find no difficulty in making any required eyepiece.— *Work, April, 1892.*

To Fix Paper on Glass or Metals.—The *Revue Photographique* gives the following, which is said to be excellent: Mix 30 gm. tragacanth and 120 gm. gum arabic, and dissolve in 500 gm. distilled water. Filter and add 2.5 thymol dissolved in 120 cem. glycerin.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Public Office.—On the day of Grover Cleveland's inauguration we received the following request from a subscriber:

"It is my intention to make application for appointment to the office of microscopist in the service of the bureau of Animal Industry. May I call for the assistance which you can render me in the way of a letter of opinion as to my qualifications?"

The reply made may be of interest to others similarly minded:

"Before taking any step of the sort desired, I should like to know by whom the place is already occupied. Is the occupant capable or incapable? Is he a man thoroughly devoted to his work, or did he neglect his work in the late campaign to talk politics? Is he one of the Harrison victors to whom belonged the spoils four years ago? If so, we ought, as good Cleveland men, to see to it that the rascal is turned out; but what is to be gained if we turn out one rascal to make place for another? It is our recollection that the fellow wanting the place never considers himself the rascal; it is always the incumbent who is the rascal. Being disciples of Grover Cleveland, we think the rascals should be kept out so as to save a President the trouble four years hence of "turning the rascal out." In short, if the present incumbent is holding his place by hard work, and remembering in a practical manner that public office is a public trust, we shall not help to put him out. If he is a spoilsman, we want to see him replaced, not by another spoils hunter, but by a man who will show by his conduct that he holds public office to be a public trust, and incidentally we hope he will be an advocate of tariff reform and of one-hundred-cent dollars."

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

135.—Are the beautiful eggs of insects marked as we see them, when laid? How are they prepared?—Insecta.

Insect eggs are naturally marked as we see them. The writer has stripped a female Ephemera Vulg. and received the eggs in a microscopical tank of water. The eggs were beautifully marked from the beginning, and remained so until hatched, 26 to 30 days later. Insect eggs may be mounted dry or in balsam in a cell.

136.—If a bud taken from a fruit-tree in midwinter be sectioned, how much of the future fruit or embryo may be seen? —E. C. H.

In the case of trees that produce blossoms before the leaves are fully developed, the flower-buds would show the rudimentary ovaries. The leaf-buds and flower-buds of some fruit-trees, as the peach, are on different parts of the stemlets, and the flowers develop before the leaves.

137.—How may I imbed small insects and make sections of material containing chitine?— W. W. N.

Insects may be imbedded in celloidin. Openings should be made in the side of small insects, and the large ones divided into lengths so as to open the body cavity and allow the celloidin to penetrate and support the internal structures. A strong chisel-like knife should be used, and rather thick sections expected. Chitine cannot be softened except in strong acids, which would destroy the softer parts of the insect.

138.—The Washington Micro. Society has a slide containing the Lord's Prayer, written with a diamond, in a space of the one twenty-eight-thousandth part of a square inch. How was it done?—L. M.

The instrument used by Mr. Webb for producing these objects was practically a small pantagraph. A stylus, attached to an arm, was traced over a "copy," and this motion, reduced by levers, was followed exactly by the diamond splinter and thus traced on the glass. It is said that Mr. Webb was accustomed to write the Lord's Prayer in spaces of the 1-500th to the 1-1,000th part of a square inch, and occasionally to the 1-405,000th part of a square inch. These numbers mean surfaces. The Washington object is written in a space of about 1-167 inch square. The finer writing occupies a space of about 1-636 inch square.

The *Am. Mo. Mic. Journal*, vol. vii, page 115, contains some information regarding minute writing by Mr. Webb.

139.—What is the best method for resurrecting blood corpuscles from blood stains and clots, and how best mounted?—H. M. F.

No method has yet been devised which will satisfactorily restore dried blood. A prolonged soaking in a fluid of the same specific gravity as blood serum, say a $\frac{3}{4}\%$ solution of salt, or a glycerin solution, or some such fluid, will soften the clot, but the corpuscles will never regain their normal form and size; they will be distorted, wrinkled, and shrunken. If one will consider the extremely delicate and peculiar character of blood corpuscles, it will be evident that changed blood cannot be completely restored. If corpuscles be removed from the flowing blood current by escaping into the tissues, or even when stagnated in the end of a tied artery, a clot is formed and the corpuscles adhere to each other. This is a physiological condition, the first stage of a disorganization and reorganization into a proper tissue, or at least into a harmless tissue in the case of the tied vessel, when the blood forms a fibrous plug, and later a harmless, shrunken cord. If blood is designed to change rapidly for the purposes of nutrition or repair, the restoration of a dried clot seems hopeless, but the field is open for original work in this line.

140.—How may sections of vegetable tissues imbedded in celloidin, be stained and cleared so the celloidin will become transparent?—B.

Tissues should be stained in bulk before being imbedded in celloidin. This substance, being practically cellulose, will be stained or discolored by nearly all the ordinary staining fluids, and the color cannot be discharged except by a chemical, which would also bleach the section.

141.—What is the duty on English microscopes imported into the United States?—Dr. Evans.

If for private use, 40 per cent. ad valorem. If for colleges or schools, and so proven, free of duty. See article on this subject in the *Microscopical Journal* for January, 1893.

142.—I am troubled by the slow hardening of my balsam mounts. Can I use mild heat, or can you suggest some other medium for quick work?—Amateur.

All balsam solutions harden slowly after the exposed surface has solidified. Mild heat is often used to hasten the hardening of balsam mounts. If the object will bear it the excess of solvent may be boiled away, or evaporated more gently over a lamp before covering, and the cover applied while the balsam is hot. When cold such mounts may be cleaned and finished immediately.

PRACTICAL SUGGESTIONS.

To Prevent the Reddening of Canada Balsam.—The tendency of Canada balsam to become red may be checked, and the balsam bleached, by the addition to the solution of a few crystals of pure metallic copper, precipitated from a copper sulphate solution by any of the ordinary methods. This process originated with the late Allen Y. Moore, of Cleveland, Ohio, and was the result of accident. What the philosophy of it is we do not know, as the copper crystals do not seem to be changed in any manner, even after long immersion in the solution of balsam.—*National Druggist, Dec. 1, '92.*

Bleaching.—Many drug sections require to be bleached before staining, but all traces of the bleaching material must be removed also. This, however, destroys and removes all the cell-contents.

Silk, wool, and similar fibres may be bleached by sodium superoxide(Na_2O_2), which is soluble in water. The liquid is neutral. The bleaching requires from 2 to 3 hours.

SCIENCE-GOSSIP.

To Measure the Magnifying power of a Microscope.—A camera lucida of some sort should be placed over the eyepiece to obtain the best result. A very simple one, indeed, may be made of a square of thin covering-glass tilted at an angle of 45° to the optic axis of the instrument. If with this arrangement the microscope tube be placed in a horizontal position, and we look down onto our piece of thin glass, the field will apparently be projected onto the table. Under these circumstances, the eye-end should be exactly 10 inches above its surface, and the whole instrument must be propped up until it is at this distance. We now require a stage-micrometer and a rule accurately divided to tenths of an inch. This latter we lay upon the table, 10 inches from the eyepiece, so that the magnified image of the divisions of the stage-micrometer shall be superposed on those of the rule. We then note how many divisions of the stage-micrometer correspond with any given number on our rule, and, dividing the latter by the former, obtain the magnifying power. For example, suppose that our stage-micrometer is divided to .001 inch, and suppose that 3 of its divisions = .003 inch exactly correspond to 0.6 inch on the rule. Then, dividing 0.6 by 0.003, we get 200 as the magnifying power with that object-glass, eyepiece, and length of tube. Had four divisions coincided with $\frac{1}{2}$ inch on our rule, the microscope would have magnified 125

times, and so on. The camera lucida is not absolutely essential, as the observer may view the stage-micrometer in the microscope with, say, his right eye, and holding the rule 10 inches from his left, shift it about until the image of the stage-micrometer is superposed on it as before; but this method is inferior both in comfort and accuracy to that described.—*English Mechanic.*

Objectives with Correction Collars.—In 1829 Amici first noticed that high-power objectives, which gave a perfectly clean image when objects, not covered with a glass, were examined, did not give so good a one when the object was covered, and that the clearness of the image increased and diminished according to the thickness of the cover-glass. To remedy this defect, which resulted from spherical aberration, Amici constructed his objectives in such a manner that they could all be used with cover-glasses of a definite thickness.

In 1837 the celebrated English optician, Ross, though ignorant of the discovery of Amici, made the same observation, and, to remedy the defect, he invented correction objectives.

In this kind of objective the two upper lenses occupy an invariable position with regard to one another. They are fixed in a movable tube, and can be made to recede from or approach the lower part, which is fixed, and carries the single or double frontal. By turning a ring the upper lenses rise or fall, and a coiled spiral spring regulates the small inequalities of the screw, and above all prevents the "back lash," which is always produced when the sense of motion is changed. The firm of Carl Zeiss engrave on their correction objectives a very practical series of figures. This series of figures, which extends from ten to twenty-five (or less), indicates at once the position to be taken for any given thickness of cover-glass. If we have, for example, to study a preparation covered with a cover-glass 1½ tenths of a millimetre thick, the division 15 is placed against the index, and we shall have the best position of the lenses in which to study the preparation in question with axial light.—*From The Microscope by Van Heurck.*

Mounting Medium.—One of the best preparers of diatoms uses for a medium a mixture of Canada balsam and monobromide of naphthaline The refractive index of this mixture is much higher than that of balsam alone, while the image is clear and brilliant.

CORRESPONDENCE.

Replies to Questions.—The following questions, which were printed on page 32, have been answered by Arthur M. Edwards, M. D., Newark, N. J.

What known locality is richest in variety of fossil Diatoms ?
The California deposit that includes Monterey, Santa Monica, and Los Angeles. This is marine.

What in fresh-water diatoms ?
The fresh-water diatoms are fossil and recent. Any of those in the East of the United States—fossil—as at Bowkerville, N. H., called "Keene" and "Troy" deposits. The brackish diatoms, fossil, are found at Newark, N. J., and the fresh-water at Hatfield Swamp, N. J.

What causes determined the quantity of diatoms in any given deposit ?
I cannot answer this unless it is more definite.

Divini's Microscope.—We are indebted to Mr. E. G. Love, of New York city, for the following:

I notice on the cover of *The Microscope* illustrations of three old instruments, the first being Divini's, dated 1657. This evidently is from Schott's *Magia Universalis*, and is one of several forms which are represented as of enormous size. The one in question, for instance, must have been from 6 to 8 feet long. It has always seemed to the writer that this cut gives a wrong impression regarding the size of this old microscope; and I think we must agree with the opinion expressed by the late Mr. Mayall, that the illustration does not represent the instrument as constructed. Mr. Crisp has suggested that the draughtsman who prepared the cuts for Schott's work probably knew nothing about microscopes, and instead of representing an eye looking into the tube, he drew the full-length figure, which gives such a ludicrous effect.

This explanation seems the more probable inasmuch as in Traber's *Nervus Opticus*, also refered to by Mr. Mayall, what is evidently the same instrument is figured with the eye only.

RECENT PUBLICATIONS.

Proceedings of the American Microscopical Society. Edited by the Secretary. Part I, October; Part II, January, pp. 1–132.

On the 8th of March, 1893, we were very much pleased to receive these two parts of the report for 1892. Part I contains the minutes, the constitution, presidential address, and papers by Ewell, Biscoe, Claypole, Griffith, Holbrook, Kraüss, Kellicott, and Rowles. Part II contains papers by Sternberg, Bell, Gage, and Rogers. The place for the next meeting will be either Madison or Chicago.

THE MICROSCOPE.

APRIL,

1893.

NUMBER 4. (NEW SERIES.)

OUTFIT RECOMMENDED FOR A BEGINNER.

BY DR. W. H. SYLVESTER,

NATICK, MASS.

In regard to a microscopical outfit for beginners, I would recommend the purchase of a low-priced but substantial stand, which should be capable of having accessories added to it as the owner's needs multiply. I am in favor of American stands, as I find them to excel the European in beauty and convenience, and to be equally good in point of workmanship. Of all the American makers, I am best able to speak of Bausch & Lomb, as I have had enough experience with their stands to recommend them as the equal of any in the world. While other American makers may be doing good work, my experience with their stands is not sufficient to judge fairly. Concerning Bausch & Lomb, I can speak from knowledge, as I have owned or used the most of their stands, and know them to be convenient and unsurpassed in durability. I prefer the American pattern, but this is largely a matter of education, as a stand of the Continental pattern is capable of good work, and for an everyday working stand has some points of advantage. If the Continental pattern be decided on I would recommend Bausch & Lomb's Medium Continental Style B B, as this has rack and pinion as well as fine adjustment. The price of this is $35.00 with one eyepiece. If one desire to economize, the rack and pinion can be dispensed with and a saving of ten dollars made. The sliding tube is really very convenient and effective after a little practice. In the American style, no stand is made for the money that at all approaches in durability and utility Bausch & Lomb's Model at $25.00. To this, almost any appliance can be added. It is thoroughly made, and adapted for any class of work, although

not so handsome as some of the other styles. It has a strong thin circular stage, to which can be added, when desired, the glass stage; a large double mirror capable of swinging above the stage, saving the expense of a bull's-eye for opaque objects; the new dome diaphragm, better in some respects than the iris; and the tube can be contracted to the short standard, allowing the use of objectives corrected to that standard if desired.

As to objectives, if the idea be still to get the best possible for the least money, I would recommend those of Leitz, as they are low in price and most excellent in quality and excel in those qualities that beginners need—long working distance and remarkably clear definition. While not of extreme angular aperture, the resolving power is good. I would advise the purchase of No. 3, about 7-10 in., and No. 7, about $\frac{1}{8}$ in. I should also suggest a double nose-piece so that both objectives may be kept on all the time while at work, as one will often neglect to use the proper power if it must be screwed off and on each time. No one accessory is of so much use as the double nose-piece. A camera lucida will be needed, and as good a one as can be afforded, though the common one at $1.50 will do good service. An eyepiece micrometer will also be needed, and one can be fitted to the eyepiece at a cost of $1.50. I would advise the selection of a B eyepiece and disc micrometer, if only one is to be purchased. Of course A and C would be better, but it is surprising how little use in real work there is for more than one eyepiece. If one can possibly spare $5.00 more, I would advise that this stand be fitted with the adjustable mirror bar, as it will be needed when a condenser is purchased and is far more convenient for everyday work. Of course I could name many more useful accessories, but I adhere to the terms of the question and name really efficient outfit for a low price. I would not advise any one to purchase a lower priced outfit who intended to do anything more than play with the microscope. As to the second question, I know of no more interesting line of work than microscopical botany, and there is this advantage—that material can be had anywhere for nothing.

Outfit recommended:	
Model Stand and B eyepiece, ...	$25.00
Camera lucida, ...	1.50
Disc Eyepiece.	1.50
Double nose-piece, ...	5.00
Leitz objectives:	
No. 3, ...	6.75
No. 7, ...	13.50
Total	$53.25

INSTRUMENTS DESCRIBED.—I.

By the Maker.

Zentmayer's American Student Stand, Patented 1876.—Responding to our specifications on page 31, the house of Joseph Zentmayer contributes the following:

This instrument was designed and constructed with the view of enabling students to obtain an instrument combining the essential features of a first-class stand, superior optical qualities, and extremely low cost.

The instrument is of brass, with the exception of the base, which is of cast-iron, neatly japanned. The base is of one piece and very rigid, to which the bell-metal bar is attached by a joint, allowing the use of the instrument at any angle of inclination, perpendicular and horizontal positions being indicated by stops.

The coarse adjustment for focus is accomplished by rack and pinion.

The fine adjustment is of the same style as that of the American Centennial stand. A concealed lever is acted upon by a micrometer screw, and moves the entire body, which is fitted to the grooved bar, giving steady and delicate movement.

The plane and concave mirrors are hung in a plane with the object, and may be swung over the stage for illuminating opaque objects (instead of the bull's-eye condenser), having the object as the centre.

The stage is broad and firm, is only three (3) inches from the table, and is provided with delicate spring-clips, which may be removed if desired.

The diaphragm is circular in form, with a series of different size apertures.

38. American Student stand, with 1 eyepiece (A or B), 1-inch objective, 19°; 1-5 objective, 75°; walnut case, with lock and handle, ... $46.00

39. American Student stand, with 1 eyepiece, and walnut case, with lock and handle, . . . 30.00

ZENTMAYER'S AMERICAN STUDENT STAND.

This stand is the same as No. 38, except that the coarse adjustment is accomplished by sliding the body-tube in a cloth-lined outside tube, which gives an exceedingly smooth and delicate movement.

38B. American Student stand with one eyepiece (A or B); 8-10 in. objective of 19°; 1-5 in. objective of 75°; walnut case, with lock and handle, ... $38.00

39B. American Student stand, with one eyepiece, walnut case, with lock and handle, . . 22.00

extra eyepiece for Student stand, . . 5.00

Carmine.—A useful preparation is Grenacher's alcoholic borax carmine, made by dissolving borax, 4 grams, in distilled water, 100 c. c., adding carmine, 3 grams, and heating gently; 100 c. c. of 70 per cent. alcohol is then added, and the solution filtered, if necessary, before use. The sections, after staining, are tansferred to alcohol (70 per cent.) containing half to one per cent. of hydrochloric acid (sp. gr. 1.16).

EXAMINATION OF POLLEN TUBES.

By Henry Shimer, M. D.

MOUNT CARROLL, ILL.

The fertilization of plants is effected by pollen tubes which reach down through the pistil to the ovary. The pollen is carried by the wind or by gravity to the pistil and, adhering thereto, sends down a shoot to the germinal vesicle of the ovule. Unless this process takes place no seeds can mature and no plant reproduce its kind normally.

Having lost considerable time in studying the "shepherd's purse" and the *stramonium* as recommended by certain books, I at length obtained success with other plants, the knowledge of which may be of interest. Professors Goodale and Strasburger advise students to produce these growths artificially with sweetened water, and give formulæ for use with pollens of several different plants named, but these are plants not readily at our command.

Gray in his "Structual Botany," p. 283, refers to a buckwheat pistil. Several of these studies require sections to be made. This is troublesome and few undertake it.

I have had good views of pollen tubes in my studies of apple blossoms, and especially in the syringas, which gave me the longest free tubes of all. By looking among the flowers, I often found a few free pollen tubes; but when I accidentally found them in the pistils of the grasses already prepared for examination, and in the greatest number that could be wished for, it gave me an intense joy which I had never expected.

These pollen tubes are little root-like sprouts, one or more from each pollen grain. I think I usually see but one from a single pollen grain of the grasses. These tubes may be seen *in situ* on the stigmas of the cultivated grasses better than on the stigmas of any other flower that I have examined. These grasses have a very delicate, white, branching pistil. The style and its branches are pale, white, and translucent. The style divides into two branches near the little seed. There are many little branchlets on each one of these styles. They are like little limbs surrounded by tooth-like tubes or cells. These cells correspond to the papillæ on the stigma of the higher developed flowers, as the apple blossom. The stigma of the apple shows these papillæ projecting from the crown of the stigma, the lower part of the cell being imbedded in the body of the stigma. But in the grasses these spur-like papillæ stand around the branch in close leaf-like order. They are short, projecting about 25 microns or 1000 of an inch long beyond the body of the branch, and about

10 microns or 1-2500 of an inch in diameter. Each one of these is a single cell. The lower part, somewhat longer than the projecting part, clasps the body of the limb, reaching down to the axil of the next cell.

These surround the vascular centre of the branch. They really seem by their union to form it, making a most excellent arrangement for receiving the pollen grains. In English blue-grass these are about 20 to 30 microns, or averaging about 1-1000 inch in diameter; in orchard grass and K. blue-grass, about 30 to 35 microns. These grasses are good for studying the sprouting of the pollen grains and for tracing the tubes down the style to the ovule. Those grasses that have pale white stigmas are much to be preferred to those having red or purple stigmas.

Kentucky blue-grass blooms in May and June; orchard grass soon follows; next comes the English blue-grass, in June and July. It has a very delicate plumose, clear stigma, and makes a good study.

In the common oats I have found a stigma that offered much interest. The pollen grains are larger, 40 to 50 microns, or 1-625 to 1-500 of an inch in diameter. The "red top" is a very good grass for study. The late flowering grasses, as the Muhlenberg grasses, Panic grasses, etc., with red stigma, do not afford so good material. The common timothy is of all the very best. At the right time it gives the grandest sight among the pollen tubes that I have seen. Although timothy blooms in July, a few heads can be found until the hard frosts kill the heads.

In 1891 I mounted some pollened timothy stigmas in glycerin, though they look the best in fresh water. Dr. Stokes, to whom I sent a slide, wrote:

"Your slide of pollen tubes is most remarkable. Never have I observed pollen tubes as they are in the mount you kindly sent me. I have seen the tubes, of course, but never such an exhibition of them."

On a clear summer morning, with plenty of dew on the grass and no wind, if the timothy is in blossom, its pollen sacs will be seen hanging on the filaments at daylight, and the plumose spreading stigma, moist in the morning dew, projecting out between the palets ready to receive the pollens. As the sun shines on the pollen sacs they burst open. If now we give the stalk a gentle shake, we shall see the numerous pollen grains, dust-like, falling and floating off in the air. If the morning is windy, much of this will be blown away. We will not get a stigma well-filled with sprouting pollen grains. But when the morning is still, many more of the grains will lodge on the plume of each stigma, and because of its closed head, much more in timothy than in the other grasses. Do not disturb the head until near noon. Give the pollen grains time to sprout and the tubes time to descend the

style. I have made excellent slides at 10 A. M., or later in the day, unless it was so hot and dry as to dry up the stigmas. I get the best slides of pollen tubes just as the bloom turns purple —often by hundreds on the same stigma.

Some notes I made July 2, 1891, read thus: "The stigma was beautiful. The adherent pollen grains had developed tubes in great numbers, some just beginning to sprout, while others had already sent their tubes down the style to the ovule. The pollens lodged on the branches of the stigma, with their tubes, are easily seen with a "C" eyepiece and a ½-inch objective. The tubes are slightly yellow tinged, and are in plain contrast with the pure white arborescent stigma. The pollen grain does not often sprout at the point of its contact with the stigma, but the tubes come out at certain points prepared by nature for that purpose—an opening in the extine through which the tube of the intine like a glove finger pushes out. As the tube pushes out I see the extine rolling out in a collar-like ring. The tube at first is like a nipple, but as it grows into a tube it hugs closely around the circumference of the pollen grain, and thus it feels for the stigma. Very often when it has appeared too far away it makes a square-angled turn after encompassing ¼ of the circumference of the pollen grain, and thus arrives at the stigmatic tissue, where it passes down over the surface of a stigmatic cell, not penetrating into it, until it comes to an interspace between the cells. Here it finds an entering point by absorbing the contents of the gland cells of the stigma through their walls without breaking the cells open. Thus it gains space to enter into the style by the application and use of the material of the cell, in its way, for its own nourishment. Sometimes the tube makes almost a complete ring around the pollen grain before it reaches the stigma, and sometimes it makes two right-angles in its course before it reaches the stigma. Each grain seems to send out only one tube. These transparent stigmas are very fine to behold when covered with the pollen grains and tubes by hundreds.

It needs a little careful manipulation to mount the stigmas, but the inexperienced will soon learn to take out the little ovule stigmas with a needle or small knife-blade. Use a well-arranged lens fixed so that both hands are free. Place it in a drop of water on the slide. After the stigma is thoroughly wet, apply the cover with a film of water spread over it with a small knife-blade. The most important thing is to get the air away from the stigma, and it may become necessary to add a very little alcohol to the water. Alcohol spoils delicate tissues by shrinking them, so apply a very little on a knife-blade dipped in the alcohol bottle. Mount in a drop of equal parts of alcohol, glycerin, and water if you choose. Having selected good specimens to preserve, place a drop of glycerin, or of liquid glycerin jelly, or of any mounting medium,

on the edge of the cover. Draw out the water with a bit of tissue-paper. The two latter media are more easily sealed in and less likely to leak than the former. Chloral hydrate water, 5 grams to the 1 oz., preserves the tissue well and will not shrink them; but it does not answer to mount in, if there is a chance for the slide to be exposed to a freezing temperature.

A SECTION OF ORANGE LEAF.

By R. H. Ward, M. D.,

TROY, N. Y.

[From Note-book A, of the American Postal Microscopical Club.]

This transverse section through the medium and adjacent portions of the blade of an orange leaf contains many interesting features, and it has taken the colors vividly in the double staining; but it is unfortunately so thick that its study is difficult and finally disappointing in some respects. Only at one end does the section taper to a little wedge thin enough to show details easily. This is an excellent example of the effect so frequently and fondly described, not many years ago, by the advocates of off-hand sections which, being necessarily cut too thick and also uneven, were believed to supply satisfactory details in the thin, wedge-like edges that were almost inevitably produced by that method of slicing. In this case, as usually, the thin shred at the end is so far the best of the whole as to make us wish that the entire slice was equally thin, and to satisfy the last unbeliever, if there is still such an one, that the day of thin, machine-cut sections has fully and deservedly come.

This is a typical and very distinct example of the prevailing constitution of leaves, which with comparatively few exceptions are bilaterally symmetrical, *i.e.*, with the lateral halves, on each side of the general axis in the centre of the midvein, essentially equal and alike; but vertically unsymmetrical, the upper and the lower portions not being similar halves or segments of any size, but differing markedly in form and constitution, and thus giving a so-called bi-facial or "dorsi-ventral" character to the leaf.

First at the top is seen, best under the 1-4th or 1-5th inch, the epidermis, of small, more or less tubular cells, without chlorophyll, that scarcely take a slight pink tint in the staining. That portion of the walls of these cells that is exposed to the external air has covered itself with a continuous filmy and colorless pellicle called the cuticle, which, though an extremely delicate and trans-

parent membrane, is of a corky character, and nearly impervious to air and moisture. This is very well developed here, as in many other evergreen leaves, to which it renders an important service in protection from atmospheric conditions. It does not take the stain here.

Below the epidermis are two tiers, more or less, of nucleated chlorophyll-bearing, columnar cells, some four or five diameters long, rather closely packed together in the "palisade" style at right angles to the plane of the surface. This dense, sub-epidermal tissue, which is well seen only in thin tip at the end of the section, constitutes nearly the upper half of the leaf's thickness. By its compactness it gives the firm texture and the dark green color to the upper side of the living leaf, and enables it to maintain an active state as an evergreen during long periods of heat and dryness.

The lower half or more of the blade is a loosely arranged, spongy, parenchyma, with much larger, thin-walled cells of irregular forms and sizes, with rounded outlines little flattened by crowding, and easily permeated by air on account of the numerous intercellular spaces thus remaining. Near the bottom the cells are smaller and more compact, and therefore polygonal, forming a moderately dense hypodermal tissue, and covered below by an epidermis and cuticle, which are not so well developed as those of the upper surface. * * *

The fibro-vascular bundles which constitute the framework of the leaf are, where they happen to be cut transversely, finely displayed by the yellowish-green staining; and with their abundance of large ducts and of very thick-walled fibres they are seen to be remarkably adapted to the two objects of the structure—the firm support of the blade, and the rapid transmission of sap. Several dashes of green staining, at many points along the centre of the thickness of the blade, indicate spreading fibro-vascular bundles of unequal degrees of perfection, from well-formed bundles to mere hints of the same; and at various degrees of obliquity, from longitudinal to nearly transverse. The longitudinal, which should be most instructive, are badly handicapped by being buried in such an excessive thickness of section; the oblique are showy, but so confusing that it is difficult to make out anything accurately about them—a fact which is common to oblique sections generally, and which has caused them, though showy and formerly popular, to fall into disuse.

One of the most attractive and profitable experiences for a beginner in microscopy is to cut sections of various fresh leaves, and examine them carefully in water under a cover-glass, if not supplied with many permanent mounts, looking for the various features above described, and noting how they vary in different plants.

PREPARING DRUGS FOR EXAMINATION.

By A. F. Rogers.

Fresh vegetable tissues often cannot be sectioned without previously being hardened. But this may be accomplished by soaking them for 7 to 10 days in pure methylated spirit. This should be changed every day and until all color has ceased to appear. Preserve in alcohol until the tissues are wanted for sectioning.

But frequently drugs are dry and very hard; they must then be softened by soaking in water with a little methylated spirit, or even soaking in hot water. Sometimes a three per cent. solution of potassa can be safely used—that is, in cases in which the cell contents, being injured, unfit the section for examination.

To make sections of soft stems, ovaries, etc., by hand, take the specimen between the thumb and forefinger of the left hand, hold the finger horizontally so that its upper surface may form a table on which the blade of a razor may slide, keep the handle of the razor in a line with the blade, and draw it from heel to tip through the specimen and towards yourself; keep the blade well wet with very dilute alcohol, and float off the sections as they are cut into a saucer of water.

The drug is, however, frequently too hard for section-cutting by hand; it is then necessary to use a microtome. The Army Medical Museum pattern is more frequently used in this country. This is simply a brass well, into which fits a very finely cut screw. The instrument having been firmly fixed to a table by means of a clamp screw, the specimem is imbedded in a piece of carrot, or in a mixture of lard and hard paraffin; the whole is put into the well, and, as the screw is turned and gradually pushes out the whole of the contents of the well, sections are made with a razor or section knife. This is nothing more than a large razor without a handle. The knife and specimen should be kept well wet with dilute alcohol, and the sections may be kept until wanted in slightly diluted spirit.

It is not necessary to use rectified spirit in section preparing, but the methylated spirit must not contain any kind of gum. A rough-and-ready test of the fitness of the spirit is to pour it into water; it should not affect the brilliancy of the water in the slightest degree. For very friable tissues a special treatment is required. First, soak the drug in strong alcohol, then in ether. Now prepare a solution of celloidin in equal parts of alcohol and ether, about the thickness of glycerin (reserve one-third of this solution). To one-third of this solution add its own bulk of alcohol and ether in equal parts, and to the remaining one-

third add twice its bulk of alcohol and ether in equal parts. Take the tissue out of the ether and put into the thinnest of the above three solutions for a few hours, then transfer to the thicker one for three or four hours, and, lastly, to the thickest for a day; take out and dry in the air, and place in spirit until quite hard and opaque. It can now be easily cut.

The sections will be much more easily examined if they are stained one or more colors, and if they are to be stained they must usually be first bleached. First, wash out the spirit by placing in water, and then bleach by soaking in *liquor sodæ chlorinatæ* for from two to ten hours. When all the color has disappeared from the sections, wash them in water three or four times at least. They can now be kept in spirit until required.

Judson's dyes were at one time used for staining these sections, but now specially prepared stains are more generally used, which can be bought, or made if more than a very small quantity is required.

The spirit should be first washed out of the specimen. It should then be immersed in the staining fluid for from three to ten minutes, and washed in spirit for from ten to fifteen minutes. Lastly, the section, which now presents a dull appearance, is cleared by placing in some clove oil until it sticks in (usually about five minutes); it will then be found to be quite clear, and ready for mounting in Canada balsam, or, more conveniently, in a mixture of Canada balsam and one-fifth its bulk of pure turpentine.

The brightness of a section stained with borax-carmine is increased by placing it in a mixture of spirit and one-sixth its bulk of hydrochloric acid for a minute or so. The acid must afterward, of course, be thoroughly washed out.

If a section is over-stained it may be remedied by placing it in a dilute spirituous solution of hydrochloric acid, or dilute aqueous solution of acetic acid, according to the stain used.

Double staining is accomplished by using alkaline and acid solutions respectively: for example, green and red, by first placing in an acid green solution, washing with water and then placing in borax-carmine solution; then wash in spirit, and clear in olive oil.

Clove oil is a very good clearing medium and a very good vehicle in which to preserve the sections until required for mounting, if it is intended to mount them in Canada balsam. If a specimen is stained before it is sectionized it must, of course, be left in the stain hours, and perhaps days, instead of minutes. This is only done with soft tissues, such as ovaries, which should be gathered before they are quite ripe. Fresh stems should not be more than three years old as a general rule.

Sections must not be bleached where there are cystolithes or

any other cell contents which the bleaching fluid would dissolve. Certain resinous drugs, such as pellitory, must not be mounted in Canada balsam, which would dissolve out the resin; in such cases glycerin jelly, containing carbolic acid, arsenic, or some other preservative, should be used. This is best used, not with a rod, but filtered, while hot and liquid, through cotton wool directly onto the slide. To keep glycerin in is a very difficult matter. Gold size which is at least ten years old and quite "tacky" or sticky is a very good cement, but it should be touched over about every five years.

Certain black cements are very liable to run into the Canada balsam and spoil the sections.

VEGETABLE STAINS.

[From Pharmaceutical Journal and Transactions.]

Hæmatoxylin.—The formula for Ehrlich's ammoniated hæmatoxylin is: Hæmatoxylin, 2 grams, and ammonium carbonate, 0.4 gram, are dissolved in proof spirit, 40 c. c., and exposed to the air in a shallow dish for 24 hours. The volume is then made up to 40 c. c., with proof spirit, which is warmed, if necessary, to dissolve any separated crystals. Ammonia alum, 2 grams, dissolved in distilled water, 80 c. c. is then added; together with glycerin, 100 c. c., rectified spirit, 80 c. c., glacial acetic acid, 10 c. c. The solution is ready to be diluted for use straight way and does not deteriorate by keeping. Sections when stained with it are of a violet color, but this may readily be changed to blue by washing in an aqueous solution of sodium bicarbonate ($\frac{1}{2}$ grain in 1 ounce). As soon as the color is satisfactory, the sections should be transferred to 70 per cent. alcohol, for if kept in water the color is apt to fade. Over-staining may be remedied by the addition of one-tenth to one half-per cent. of strong hydrochloric acid to the alcohol and subsequent washing with the sodium bicarbonate solution already mentioned.

Plasmatic Stains.—Alcohol must be removed from the sections by placing them for a minute in distilled water, after which they may be transferred to the plasmatic stain. To follow hæmatoxylin, this may be water, soluble eosin (1 gram in 40 c. c. of alcohol and 160 c. c. of distilled water), erythrosin (same strength as eosin), or orange (2 grams in 20 c. c. of alcohol, and 80 c. c. of distilled water). After using carmine, picric acid (1 gram in 100 c. c. of 70 per cent. alcohol) affords a suitable const. In each instance, afterwards wash with 90 per cent. alcohol.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

The Microscope in Pharmacy.—There is a constant progress observable in the use of this instrument in drug stores. The pharmaceutical journals are giving more and more attention to the subject. In the present number of *The Microscope* will be found an article on drug examination which we have condensed from one of our pharmaceutical exchanges.

The schools of pharmacy now see the need of instruction in microscopy and are establishing chairs devoted to that subject.

The School of Pharmacy connected with the University of Kansas is under the direction of Prof. L. E. Sayre, who contributed an article to the February issue of *The Microscope*.

Tuition in this school is free. The State, convinced of the necessity of sound training for those who stand in such close relation to the public health, has provided this school with the view of putting within the reach of all young men and young women of the State, who choose to avail themselves of its advantages, the very best instruction in the theory and practice of pharmacy. It supports the school generously from the State treasury, and looks to no pecuniary return from the students. In botany, physiology, chemistry, and physics the students of the School of Pharmacy have the benefit of the instruction of the university, and use its laboratories and collections. There are thus, besides the special pharmaceutical laboratories, two chemical laboratories (for qualitative and quantitative analysis), microscopical laboratories (for structural botany and pharmacognosy), and a physical laboratory.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

143. What is the best method for mounting starch, pollens, etc., for the polariscope? What medium is best, and how may I keep the grains in the centre of the mount?—Novice.

Place a small drop of oil of cloves on the centre of a cover-glass, and sprinkle the starch into it. With the corner of a slip of hard, smooth blotting-paper absorb the surplus oil, add a drop of balsam, and set aside, covered from the dust, for twenty-four hours. Drop sufficient balsam on the centre of the slip, place the prepared cover, stiffened balsam side down, in the fresh balsam on the slip. Apply a gentle pressure and let the cover slowly settle against the slip.

Two or three different sorts of starch or pollen may thus be mounted under one cover; and if carefully done, but little mixing will take place. If the balsam on the cover be well hardened the group or groups will not spread at all.

144. Describe the best way of cleaning diatoms without the use of acids.—E. P. W.

Put the material in a flask with pure water; insert a cork with a tube in it. The tube should reach nearly to the water inside the flask, and extend outward a foot or more in length. Boil continuously, over a lamp, for several days, or until the diatoms may be seen to be clean. The long tube acts as a sort of condenser and returns most of the steam as water, thus serving to maintain the level of the latter with but small loss. The material may be kept boiling by the hour, without attention. A little soap added will sometimes assist in cleaning away flocculent matter.

145. What is the best way of illuminating opaque objects for examination with ½ inch to 1-5 inch objectives:—E. P. W.

A bull's-eye condenser or the concave mirror swung above the stage may be used with the lower powers. A Lieberkühn, which is a concave metallic mirror, affixed to the objective, may be used. This reflector receives the light from the mirror below, and focuses it on the upper side of the object. With the higher powers, Smith's vertical illuminator may be used. This is a reflector inclosed in an adapter which is screwed to the nose-piece of the microscope, above the objective. The reflector is a thin cover-glass and receives the light from the side, reflects it down through the objective lenses, upon the opaque surface. These instruments may be had at the dealers in optical apparatus.

146. Where can prepared sections of bone be procured? —J. I. P.

The dealers in microscopical preparations will supply such mounts.

147. An accidental pressure upon the cover-glasses of some mounts caused the medium to exude, and the covers slip down when the slide is placed on edge. What were the defects in mounting?—E. L. S.

Many mediums remain soft under the cover. All such mounts should be protected with a finish of good tough varnish around the edge of the cover.

148.—How may I compute the magnification of an object photographed with or without an eyepiece, and at different distances from the objective?—A Novice.

The easiest way to find this magnification is to remove the object after photographing it, put a stage micrometer in its place, throw the image of the lines on the ground glass, and compare them with an ordinary rule. This will give the correct magnification produced by that optical combination. To compute it more or less accurately, reckon that an inch objective will amplify 10 diameters at 10 inches from its optical centre. If an inch eyepiece is used, multiply again by 10; other objectives, eyepieces, and distances in proportion.

Nelson's formula is, $\frac{DO}{AB}$ = magnification. A = focal rating of eyepiece. B = focus of objective. O = optical tube length (from optical centres). D = distance from object to eye or ground glass. As eyepieces and objectives are rarely rated correctly, computation by any rule will give approximate results only. See *A. M. M. J.*, vol. vi, page 141.

SCIENCE-GOSSIP.

Specific Stains.—Carmine, hæmatoxylin, and most of the anilin dyes stain unaltered cellulose, whilst lignified tissue may be permanently stained with methyl-green (0.25 gram in 20 c. c. of alcohol and 80 c. c. of distilled water). Squire's process for double staining stem and root sections containing cellulose and lignified tissue is to first rinse in distilled water, then place in methyl-green solution for 3 or 4 minutes; again rinse in water, wash in 90 per cent. alcohol for 5 or 10 minutes, place in Grenacher's alcoholic borax carmine for 15 or 20 minutes, rinse quickly in water, and pass through 90 per cent. alcohol. Chlorzine iodine colors cellulose blue, and lignin yellow or yellowish

brown, the latter being also colored red with phoroglucin (1 gram in 20 c. c. of alcohol and 80 c. c. of distilled water) and strong hydrocholic acid, and yellow with anilin chloride (2 grams in 65 c. c. of alcohol, 35 c. c. of distilled water, and 2 c. c. of strong HCl). Hoffmann's blue or eosin is specially useful for distinguishing sieve areas.*

Gum Thus.—Gum thus, or frankincense, is obtained from the tree of the pine. I procure it from the L. R. Barnard Chemical Co., dealers in dye-stuffs, chemicals, acids, oils, etc., at 58 Market street, Newark, N. J. I dissolve it in commercial alcohol with moderate heat, and then pour it off from the sediment. To this, three parts, I add one part of oil of cinnamon. It is used like Canada balsam, but dissolves in weak ammonia, alkali, carbonate of ammonia, soda or potash or borax. These, can be used to clean the slides from superabundant medium. Those who have tried it speak in flattering terms of it. It is of a high refractive index, makes diatoms come out well with an ordinary one-fifth, and resolves the *Amphipleura pellucida* with a one-twelfth immersion. The color, lightish brown, is bad, but I will bleach it by and by. Cholorine does not bleach it well.—*Arthur M. Edwards, M. D., Newark, N. J.*

RECENT PUBLICATIONS.

Medical Microscopy. By Frank J. Wethered. 12mo. Phila, delphia. P. Blakiston, Son & Co., 1892. pp. 406-cuts 101.

A book so clear and consise as this, so compact and so essential to the practitioner, ought to sell by the hundred thousand. How a physician of to-day can practice medicine intelligently without using a microscope continually passes our comprehension. The examination of urinary deposits, of fæces, of sputum, of vomit, of blood, of genital discharges, of cutaneous parasites, of suspected food and water, not to mention tumors, tissues, and nerves are all necessary to a proper understanding of the cases daily presented to the physician. What can be seen with the microscope and how to see it are fully set forth by the author. Of elementary microscopy, there is perhaps enough to enable the novice to begin the use of an instrument. There are chapters on hardening and decalcifying, on imbedding, on cutting sections, on staining, on clearing and mounting, on the construction and use of microscopes and accessories. Bacteriology gets a chapter at the end of the volume. We hope to arrange to furnish this book to our subscribers at a reduced rate.

*Schulze's solution: prepared by evaporating 100 c. c. of liq. zinci-chlor. B. P. to 70 c. c. and dissolving in it 10 grams of potassium iodide. Add 0.2 gram of iodine and shake frequently until saturated.

THE MICROSCOPE.

MAY,

1893.

NUMBER 5. (NEW SERIES.)

OUTFIT AND WORK FOR BEGINNERS.

BY H. L. OSBORN,

SAINT PAUL, MINN.

For the majority, I should recommend a good low-power objective, say $\frac{2}{3}$, and a stand to which could be added later a good $\frac{1}{5}$-inch.

The Bausch & Lomb Continental A stand costs $18, and the $\frac{2}{3}$-inch objective $7—total, $25. When you buy the $\frac{1}{5}$-inch objective it will cost $15 more. The B. & L. Library stand ($10) and 1-inch objective ($16) is capable of good work. I should say that microscopes of about that grade are the cheapest that are worth having, and I should advise buying the Continental in preference to the Library.

When you have secured the instrument, practice mounting and preparing objects, at first dry or in water, then in permanent mounts in glycerin jelly or balsam. Examine netting, bolting cloth, and other fabrics in order to decide in which direction the strands run. Examine paper and felt. Study the surface of every kind of leaf. Examine seeds, pollen, petals of flowers, and other floral organs. Make cross-sections of plant stems at various levels. Kill insects with chloroform; examine them whole and also the separate parts. Acquire skill by practice in preparing these things for examination. Search in water, especially salt water, for small animals and plants to examine.

All sorts of hair, scales, feathers, sand, clay, powdered minerals, etc., are interesting for low-power study. It is surprising how much can be done even with a low power or a hand-lens.

Get some book like Stokes' Microscopy for Beginners, and look up in it the explanation of what you see and the list of things which you ought to see in each kind of specimen. So far as possible, make notes and drawings of what you see. Of course, a child of ten years of age cannot do these things without a little instruction, but many young people, such as the members of the Agassiz Association, can become quite proficient with practice.

A Mounting Outfit.—The following outfit is sufficient for general microscopical work, not including section-cutting; and while it may be procured from the dealers all ready for use and even packed in a box, one can often make a considerable saving in money by collecting the items himself.

1 Turn-Table.
1 Pair Cover Forceps.
1 Knife.
1 Pair Steel Forceps.
2 Needle-Holders, Bone Handle.
1 Pair Scissors.
1 Nest of Saucers.
6 Dozen Glass Slips.
¼ Ounce Circles, assorted.
¼ " Squares, "
1 Dozen Block Tin Rings.
1 " White Metal Rings, Beveled.
1 " Ebonite Rings.
100 Square Labels.
2 Camel's-Hair Brushes with Handle.
½ Dozen Spring Compressors.
1 Brass Table, with Lamp.
1 Dropping Bottle.
2 " Tubes.
2 Dipping Tubes.
½ Dozen Watch Glasses.
1 Wide-Mouth Jar.
1 Bottle of Pure Glycerin.
1 " Oil of Cloves.
1 " Absolute Alcohol.
1 " Magenta.
1 " Methyl A, Green.
1 " Pure Benzole.
1 " White Zinc Cement.
1 " Gold Size.
1 " Brunswick Black.
1 Tube Canada Balsam.
1 Capped Bottle of Balsam.

INSTRUMENTS DESCRIBED.—II.

BY THE MAKER.

The Library Microscope.—The Bausch and Lomb Optical Company of Rochester, N. Y., wrote as follows:

"We believe that our Library Microscope with society screw, equipped with 1-inch eyepiece, 1-inch objective, will meet the wants of the Agassiz Association, and other young people, as the power is sufficiently high for beginners in natural history; and, as you say that price is an object, we believe that it will meet with your wants as such. You will find the above outfit (stand, eyepiece, and 1-inch objective) listed in our catalogue as D 1, which we will be pleased to furnish at $16.00, as listed in our catalogue. The Library Microscope equipped with 2-inch eyepiece, 1-inch and ¼-inch objectives, we can offer at $30.00.

"We, in all cases, however, recommend a microscope to which at any time the possessor can attach accessories, and would therefore recommend our Model Microscope, it having a coarse and fine adjustment, also substage, which would be preferable. The party owning it would not have to exchange it later for one having these attachments. We would be pleased to furnish a Model stand, with 1-inch eye-piece and 1-inch objective, for $31.00.

The Library stand has a draw-tube and society screw. The eyepieces are of Continental pattern; the mirror concave, swings so as to give oblique illumination, or can be brought above the stage for illumination of opaque objects. The stage has spring clips. The rack-and-pinion adjustment is delicate and suited to high power objectives."

BAUSCH & LOMB'S LIBRARY MICROSCOPE.

A DEVICE TO TAKE THE PLACE OF THE CAMERA LUCIDA IN MICROGRAPHY.

By Henry G. Piffard, M. D.,

NEW YORK.

The art of micrography, or the reproduction on paper of images of minute objects seen through the microscope, may be practised in various ways.

Some time since, it occurred to the writer that the practice of micrography could be greatly simplified by adopting the principles employed in ordinary projection, as used in connection with the optical lantern, the projection microscope, photography, etc. It was only a question of reflecting the projected image onto a piece of drawing paper fixed in some convenient position. To this end, I requested Bausch and Lomb to mount a right-angled reflecting prism with a short tube extending from one of its square faces, this tube to be of such calibre that it could be inserted into the microscope in the place of the eyepiece. From the other square face a similar short tube extends, capable of receiving the ocular and holding it firmly.

When preparing to use this device the object is placed on the stage, and focused in the usual manner. The microscope is then brought to a horizontal position, the eyepiece is removed, and the prism case put in its place, the ocular being inserted in the short tube provided for its reception. The ocular should point downward. The lamp or other source of light should then be disposed in such a way that it properly illuminates the object to be examined, it being expressly understood that no light shall escape toward the observer except that which first reaches the object. A Beck lamp is conveniently adapted to this purpose. If a piece of drawing-paper is placed beneath the ocular, and the room darkened, a brilliant image will be projected on the paper, and its reproduction can be easily accomplished with a maximum of rapidity and a minimum of discomfort. In guiding the pencil the draughtsman uses both eyes, and his spectacles if needed, and sits in whatever position he finds most comfortable. With a proper lamp, and careful utilization of its light, this device gives excellent results, with amplification up to four or five hundred diameters. If a sensitive photographic plate be substituted for the drawing-paper, an exposure of a few seconds will impress an image that may be developed in the usual way.—*New York Medical Journal.*

MODELS FOR CONSTITUTION AND BY-LAWS OF A MICROSCOPICAL SOCIETY.—I.

WASHINGTON, D. C.

This Society was organized February 5, 1884, at a meeting of the original members held in the Principal's room, High School Building, then held its meetings at No. 1321 F street N. W., and now meets at 714 13th street N. W. It was incorporated Oct. 19, 1892.

CONSTITUTION.

SECTION I.

ARTICLE 1.—*Name.*—This Society shall be known as THE MICROSCOPICAL SOCIETY OF WASHINGTON, D. C.

ART. 2.—*Object.*—The object of this Society shall be the cultivation and advancement of Microscopical Science and the mutual benefit of its members as students of the same.

SECTION II.

ARTICLE 1.—*Membership.*—There shall be three classes of members: active, corresponding, and honorary.

ART. 2.—*Active Members.*—Only practical microscopists shall be eligible to active membership. All applications or proposals for membership shall be in writing, endorsed by two members, *and accompanied by the entrance fee.* They shall be read and referred to the Committee on Membership. Said committee shall report at the next meeting of the Society for or against the admission of the candidates. A ballot shall then be taken and three negative votes shall constitute a rejection. After election the applicant shall sign the constitution.

ART. 3.—*Corresponding Members.*—Any microscopist, not a resident of the District of Columbia, who may desire to become connected with the Society shall be eligible to corresponding membership. Active members of the Society who shall remove from the District of Columbia may, upon application, be transferred to the list of corresponding members, provided they are not in arrears to the Treasurer of the Society.

ART. 4.—*Honorary Members.*—Any person eminent in science, or any person who has been the means of rendering material aid to this Society, shall be eligible to honorary membership.

ART. 5. Corresponding and honorary members shall be elected in the same manner as provided for active members, but they shall not be entitled to the privileges of voting or holding office, and shall be exempt from dues and assessments.

SECTION III.

ARTICLE 1.—*Officers.*—The officers of this Society shall consist of President, Vice-President, Corresponding Secretary, Recording Secretary, Treasurer and Curator.

ART. 2.—*Elections.*—Officers shall be elected annually, by ballot, at the first meeting in October, to enter upon the performance of their duties at the next meeting.

ART. 3.—*Committees.*—All committees shall be appointed by the Chair, unless otherwise determined. Standing committees of three or more members each on Membership and Essays shall be appointed at the next meeting after election, to serve until their successors are appointed.

SECTION IV.

ARTICLE 1.—*Amendments.*—Any amendment to this Constitution shall be proposed and submitted in writing, and read by the Secretary at a regular meeting of the Society. It shall not be voted on until the next regular meeting, when it shall be again read, and an affirmative vote of two-thirds of the members present shall be required for its adoption.

BY-LAWS.

ARTICLE 1.—*Meetings.*—Regular meetings shall be held on the second Tuesday of each month at 8 o'clock p. m., except during the months of June, July, and August, when the regular meetings shall be omitted. Special meetings shall be called by the President upon the written request of three members. Notice by mail of all meetings shall be given to all active members at least twenty-four hours prior to the time of such meeting.

ART. 2.—*Entrance Fee and Dues.*—The entrance fee shall be one dollar. Dues shall be two dollars per annum, payable semi-annually in advance. When the dues of any member shall be in arrears to the amount of five dollars his attention shall be called to the fact by the Treasurer. Failing to cancel his indebtedness within thirty days after notification by the Treasurer, the latter shall report the fact to the Corresponding Secretary, who shall thereupon notify the delinquent member that his name has been dropped from the rolls of the Society.

ART. 3.—*Duties of Officers.*—The officers shall perform the duties usually assigned to them in associations of a similar character.

ART. 4.—*Quorum.*—Five active members shall constitute a quorum for the transaction of business.

ART. 5.—*Amendments.*—These By-Laws may be amended in same manner as provided for amendments to the Constitution.

But any one or more sections may be suspended for one meeting by a vote of two-thirds of the active members present, and the regular order of business may be suspended by a majority vote at any meeting.

ART. 6. All slides, belonging to the Society, which may be in the possession of members shall be returned to the rooms of the Society at or before the meeting immediately preceding the annual Soirée.

ORDER OF BUSINESS.

(1) Reading of minutes of last regular meeting. (2) Reading of minutes of special meeting. (3) Proposals or applications for membership. (4) Reports on candidates for membership. (5) Balloting on candidates for membership. (6) Reports of special committees. (7) Unfinished business. (8) New business. (9) Reading of papers. (10) Discussions. (11) Exhibition of slides. (12) Adjournment.

If the Society is to hold property and will need to defend its property rights, the following form is recommended:

ARTICLES OF INCORPORATION.

TO ALL WHOM IT MAY CONCERN:

This is to certify that we, whose names are hereto signed, are persons of full age, citizens of the United States and a majority of whom are citizens of the District of Columbia, have associated ourselves together, pursuant to the provisions of Section 545, Chapter 18, of the Revised Statutes of the United States relating to the District of Columbia, approved June 22, 1874, and the amendment thereto, approved April 23, 1884, under the corporate name of "THE MICROSCOPICAL SOCIETY OF WASHINGTON, D. C."

This Society is to continue for twenty years unless sooner dissolved according to law.

The particular business and objects of the Society are:

"The cultivation and advancement of Microscopical Science and the mutual benefit of its members as students of the same."

The affairs of this Society shall be managed by the undersigned and such persons as may be hereafter elected members of said corporation through duly elected officers, consisting of a President, Vice-President, Corresponding Secretary, Recording Secretary, Treasurer, and Curator.

The said officers shall be chosen by ballot at the regular annual election of the corporation, at such time as may be fixed upon by the By-Laws of this corporation.

The officers or managers for the first year of its existence are: (Names follow.)

In witness whereof we have hereunto set our hands this 18th day of October, A. D. 1892. (Names follow.)

DISTRICT OF COLUMBIA, }
COUNTY OF WASHINGTON, } *ss:*

Be it remembered that on this 18th day of October, 1892, before the subscriber personally appeared the above-named (insert names), to me personally known and known to me to be the persons whose names are subscribed to the foregoing instrument of writing, and severally and personally acknowledged the same to be their act and deed for the uses and purposes therein set forth.

Given under my hand and official seal the day and year above written.

JOS. H. BLACKWOOD,
[SEAL.] *Notary Public, D. C.*

THE PRICE AND COMPOSITION OF FARRANT'S MEDIUM.

BY CHAS. W. SMILEY,
WASHINGTON, D. C.

One of our Western subscribers recently propounded a query which we have submitted to the dealers, with some rather interesting results. He demanded to know why dealers charge 50 cents per ounce for Farrant's medium, or why any one pays it when he can buy the ingredients at a drug store for less than 3 cents. (Picked lumps gum acacia, 4 drams; glycerine, 2 fluid-grams; camphor water, 4 fluid-grams. Mix, let it dissolve and strain.)

Dr. Shanks has already replied that Farrant's medium, made as suggested by F., would probably be thick and gummy, spoil the mounts, and so not be worth even 3 cents per ounce.

Bausch & Lomb make the following very satisfactory reply:

"Farrant's medium, as quoted in our catalogue, is a compound prepared after a carefully selected formula, which consists of several ingredients, and undergoes a process of preparation that is time-consuming. Hence the price."

But from several other dealers we received replies marked "confidential," and not to be printed. And yet some good ideas came along which there is no harm in printing on our own responsibility. One dealer said:

"Your correspondent appears to have overlooked the great element of cost in all articles of trade, viz., time and division of ntity. If he would order a pint in bulk instead of an ounce ld be able to charge a less rate. How would F. answer

this question: Why do slides sell for 50 or 75 cents when the glass and other materials cost only 3 to 6 cents?"

Another dealer whom we esteem very highly said that he would not answer an anonymous query and he could see no benefit to himself in answering it under any circumstances. But he added in postscript that he had never heard of making Farrant's medium in accordance with F.'s recipe, and that he was sure it did not originate in a standard text-book. Still another dealer, who declined "to enter into any published controversy on the subject," wrote the following very reasonable reply:

"We do not see what is to prevent F. or some other person, if we answer this question, from continuing to propound questions of a similar nature; for instance, the question might be: How is it that we charge 75 cents for mounted specimens of Bacillus tuberculosis when the slide only costs one (1) cent and the cover costs less than a cent and the bacilli costs nothing? In other words, the whole thing costs two (2) cents, and we charge 75 cents for it according to this theory.

"Again, why do you charge $3.00 for a slide cabinet when the lumber in the cabinet is worth less than 20 cents? Of course, it is needless to explain to such people that it is necessary to pay for labor, and that dealers must pay rents, etc. The more you say, the less they believe. If F.'s idea of analyzing the prices on microscopical material was pushed to the extreme there would be no use in our advertising our goods in the microscopical journals or by other means, as it can always be clearly proven that where a man has knowledge he can, as a rule, make up a microscopical preparation cheaper than the dealers can sell it, and if all the microscopists made up their own preparations there would be no use in the dealers advertising their goods."

F. takes no account of the bottle, nor of the skill, nor of the time consumed, nor of the need of profits. Yesterday I paid a dentist $2 for an hour's work in cleaning my teeth. Why did I not do it myself? We pay doctors for advice and for recipes which can be found in the books and medical journals.

Carpenter on the Microscope gives this: Farrant's medium is made by dissolving 4 parts of picked gum arabic in 4 parts of cold distilled water, and then adding 2 parts of glycerin. The solution must be made without the aid of heat, the mixture being continually stirred, but not shaken. Afterward the liquid must be strained through fine cambric, previously well washed out by a current of clean cold water. Keep in a glass-stoppered bottle containing a small piece of camphor.

And now we have only to add the request that subscribers who try F.'s recipe or Carpenter's and succeed with it will write to us the results for the benefit of others who feel inclined to economize their money and use their time in this manner.

ON THE DARK ROOM AND ITS FITTINGS.

By F. W. Mills,
HUDDERSFIELD, ENGLAND,
Author of An Introduction to the Study of the Diatomaceæ
[From "Photography applied to the Microscope," pp. 38–40.]

Although development may be carried out in the bed-room at night, or in a cupboard, under stairs, or in the wine-cellar, and such places, these are obviously inconvenient and quite unsuitable to any systematic scientific work being done. A room should be fitted up especially for the purpose, and the most convenient is to convert at will the room in which the apparatus stands into the dark room—in other words, make the dark room of such size that the apparatus can be kept in it.

The room should be well ventilated, this being a very important item, as when artificial light is used the air gets foul, especially when ammonia is being used. It should also have a good water supply, and a sink, over which development can be done.

Illumination.—Gas is the most convenient when it can be obtained, one jet being provided with a by-pass, the pilot flame of which burns behind a collar, thus showing no light when turned down. This does to illuminate the room on ordinary occasions, and for exposing bromide prints, etc. Another jet is placed inside a lantern glazed with ruby glass; the screen-holding glass being removable and replacaeble with one of yellow, for use during printing or the development of plates other than orthochromatic. If gas is not available, paraffin lamp or candles must be made to suffice; but these are not so generally useful as the gas, the heat from it being easily used as a means of vetilating the room. The flue from the lantern should be led out of the room. A set of half a dozen dishes of porcelain will be found sufficient. Two or three shelves ought to be fitted up to hold the bottles of reagents. The reagents required and the strengths convenient for photographic use are as follows:

Pyrogallic acid, 10 per cent.; bromide potassium, 10 per cent.; ammonia, 10 per cent.; potass. ferrocyanide, 10 per cent.; quinol, crystalline; potass. hydrate, in sticks; potass. metabisulphite; sulphite of soda, crystalline; citric acid, crystalline; ferrous sulphate, sat. sol.; neut. oxalate potass., sat. sol.; mercury perchloride, sat. sol.; thiosulphate soda (hypo), sat. sol.; powdered alum, sat. sol.

The first three substances on the list are most conveniently kept in dropping-bottles of about two to four ounce capacity, the alum and hypo being kept in stone jars. Two measuring glasses should be obtained, one of ten-ounce capacity and another of one drachm. A pair of small balances with glass pans are also required. The fixing bath should have a wooden lid to prevent dust falling in; it also prevents evaporation when not in use.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

A Great Change.—From 1881 to 1892 two American microscopical periodicals struggled along on the same plane, both fearing continually to lose advanced subscribers by catering to beginners, and dreading equally to lose their less advanced patrons because of the matter being too abstruse or "too scientific." Now, the MICROSCOPICAL JOURNAL will not hesitate to publish the most abstruse contributions to microscopy and biology. It will epitomize the information of permanent value in this science. It will not cater to beginners. THE MICROSCOPE, on the contrary, endeavors to publish nothing but what everybody can comprehend, even the 15-year-old boys, of whom several are now subscribers, as well as the people, who, while not scientists, wish to learn something of microscopy and to be able to entertain their children with something besides talk. Its matter will often be of temporary interest rather than of permanent value. It is for popular matter.

How to Begin.—If you know absolutely nothing about a microscope, you can buy a good instrument for from $16 to $30. and by taking THE MICROSCOPE you can learn how to entertain yourself and friends many a leisure hour. It is one of the most fascinating of recreations. You will need some objects for exhibition. See our advertisement of microscopic preparations illustrating vegetable life at about 5 cents each. Any question that you desire to ask you can get answered in our columns. We also offer the following premiums.

Premiums.—For every new subscription to THE MICROSCOPE accompanied with $1 we will give the choice of one of Sutton's slides of American woods. The money must be sent direct and not through any agent for you to secure the premium; otherwise the agent gets the premium.

OF POPULAR INTEREST: Ironwood (transverse section); Sycamore (tr. sec.); Spruce (tr. sec).

OF SCIENTIFIC INTEREST: White pine (*Pinus strobus*), long. sec.; Beech (*Favus sylvatica*), tr. sec.

For every new subscription to both THE MICROSCOPE (price $1) and the MICROSCOPICAL JOURNAL (price $2) accompanied by $3 we will give *one of each of the 5 slides free.* Or we will sell either of the slides at 20 cents each, which is the very low price put upon them by Mr. Sutton in his advertisement in the JOURNAL. All subscriptions should end with the volume in Dec.

New Societies.—To encourage the formation of new microscopical societies, we will send THE MICROSCOPE free for one year to ever charter member (not exceeding 15) who participates in the organization. The secretary is to send us a report of each meeting of the society for publication. A model for a constitution and by-laws can be found in THE MICROSCOPE for May, 1893.

Buying Your First Microscope.—In making a beginning in microscopical study you have to look forward to the future a little and anticipate future needs. If after a few months' practice you will want to increase your facilities and add to your apparatus you must buy your first instrument with that contingency in view. But, on the contrary, if you are not going to enlarge your outfit, you can save money by ignoring the future. A beginner may buy a stand in which the most powerful objectives will fit perfectly, or for far less money he may buy one useful only for the low-power objectives which come with it and which are sufficient for the needs of a beginner.

With this in view, we have addressed several dealers, asking what they can furnish for such beginners as the young people of the Agassiz Association, and have received some valuable replies. Later, we hope that all the other dealers will report what each can do for the beginner.

Most of the firms allow a discount to the editor of this periodical, which we will divide with those young people who are struggling to get a start in scientific work and who do not feel able to pay the full retail price.

Photomicrography.—I want to know something about this subject and where to buy instruments at reasonable prices. I will try it this summer. I lost all my slides and equipment lately by fire in the High School. After the new building is up we shall have an equipment of 10 stands and accessories. M. RICKER.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

149. How is collar correction managed? What are the appearances which call for opening and what for closing the systems? How can I arrive at the best correction and know that I have obtained it? If there is no certain and short cut to proper correction, it would be a satisfaction to know th fact.—Dan.

See article by Dr. S. G. Shanks in June number of *A. M. Microscopical Journal*, 1893.

150. Is methylated spirits the same as alcohol?—S.

Methylated spirits is common or ethyl alcohol with 1-9 its bulk of methyl alcohol (wood alcohol). The latter alcohol has a disagreeable, smoky taste and is unsuitable for beverages, therefore is duty free in England. Methylated spirits is also duty free and is intended for use in the arts.

151. What substitute may be used for the slide of the plate-holder in photomicrography with high powers? After careful focusing the withdrawal of the slide disturbs the focus. —W. N. S.

If the camera is steady and firm and the plate-holder fits as it should do, a careful withdrawal of the slide should not disturb the adjustments. Perhaps the objective is at fault; visual and chemical rays do not always come to the same focal point.

152. Will tobacco smoke injure microscopic specimens? Will tobacco smoke change the color of white paper?—R.

Tobacco smoke, like any other kind of smoke, is finely divided carbon or soot, and will injure any delicate objects, if in sufficient quantity. There are other volatile principles in tobacco, but not in sufficient quantities to produce any special effects.

153. Is the duty on imported microscopes 40 per cent.; and does this mean for everything in an outfit, including objectives, eyepieces, etc., or is the latter subject to separate duty? Can the duty be determined by adding the price of stand, objectives, eyepieces, etc.?—A. D. P. Weaver.

Yes, you must pay 40% on the price at which all such manufactured objects are billed to you. Not even an eyepiece can be sent in to you free of duty.

154. What is the most convenient and best method for producing monochromatic illumination? What are the formulæ for the ammonio-cupric solution and the sodium flame?—F. P.

The best method for producing monochromatic illumination is by the use of expensive prisms, as described in Carpenter, 7th ed., pp. 272 and 360. The most convenient method is by the use of cobalt blue glass. Ammonio-sulphate of copper may be made as follows: Take a saturated solution of sulphate of copper in water, add strong aqua ammonia until the precipitate at first formed is redissolved. The resulting deep blue solution, in a flat-sided tank, is placed between the source of light and the object. The sodium flame is best produced by dissolving a sodium salt (sodium salicytate or caustic soda) in alcohol and burning it in an ordinary alcohol lamp. The flame is deep yellow in color, but of very feeble illuminating power.

155. Can you give me information in regard to making microphotographs (minute photographs on glass, not the enlarged photomicrographs) or refer me to any book upon the subject?—X.

There is practically no practical literature on the subject, but a method may be worked out by an ingenious person. The following outlines of a method which has been successfully used may be of assistance: Make a small camera to take a plate, say, 1½ x 2 inches (a quarter plate cut in 4). Use a plain glass dabbed with putty for a "ground glass," to set against a strip of glass top and bottom, with spring clips to hold it. An inch objective in a smoothly sliding tube for focusing will serve as the photo lens. Have stops or pegs on the supporting-board or table, so the whole camera may be removed to the dark room, a sensitized plate slipped in place of the "ground glass," and the whole replaced in the former position; the back of the camera closes with a slide or door. If this combination camera and slide-holder is made wide enough a screw or rod through the side may be arranged to press against the plate and move it sidewise to several new positions, and thus allow of several different exposures of the same negative, the whole to be developed together and subsequently cut apart. The negative to be copied must be set up several feet away and very carefully and evenly illuminated. Focus on a prominent black band or mark painted on the negative film. Use a hand-lens to secure a sharp image. It will be necessary to make allowance for the different focal points of visual and chemical rays, unless the objective has been specially corrected for photo use. The old collodion wet process will probably produce the finer results in these minute transparencies. Development will be simply guess-work until experience is gained.

A microscope stand has been used in this way: Remove the eyepiece, direct the tube horizontally toward the illuminated nega-

tive, use the microscope stage for the sensitized plate. Either the stage or the negative and light must be enclosed in a box so no light will reach the sensitized plate excepting through the objective. The microscope tube may be thrust through a hole in a thin partition, with the stage in the dark room, when the plate may be exposed and developed.

Space will not allow a more detailed description. A person evperienced in photography.

See A. M. M. J., vol. x, page 276, for a short article.

156. Microphotographs. How are the miniature magnifying-glasses with photo views made.—Holiday.

See answer to query No. 155.

After the photo is made and cut down, a melted glass bead is cemented with balsam over the face of the picture. When hard, the edges are ground to fit the holder. The spherical bead acts as a lens. They are usually made in France or Switzerland, where labor is cheap.

157. Who will put me up a special mount of pygidium of flea?—A. L. W.

A.—Write to Eugène Bourgogne, 34 Rue du Cardinal-Lemoine, Paris, France, and enclose a United States dollar bill in registered letter. He will sell it to a broker for 95 or 98 cents. Write to him in French if you can. There will be no duty on the slide.

CORRESPONDENCE.

Rotifera.—Mr. H. S. Jennings, of Michigan University, is studying the Michigan rotifers and would doubtless like to communicate with others who are interested therein.

What Dr. Stowell has to say of the Microscope.—It will be remembered that Dr. Stowell, who founded this periodical at Ann Arbor, in April, 1881, is editor and publisher of *The National Medical Review*, at 1326 New York avenue, in this city. That he looks kindly after his offspring will appear from the following extract from the *Review* for May, though we regret to notice that he does not always correctly remember the ages of his children:

"Our first literary offspring, THE MICROSCOPE, now thirteen years of age, appears in a new dress, precisely like that of its younger brother, *The Review*. This is of course, very proper, as we now have a two-year-old at home and a thirteen-year-old in the charge of Prof. Smiley of this city. THE MICROSCOPE starts at volume 1, new series for 1893, and is especially devoted to the needs of naturalists, physicians, and druggists. The subscription price is one dollar a year. Address Chas. W. Smiley, Box 630, Washington, D. C."

Diatoms.—I have seen your question in February number (page 32) and would say:

If your question relates to the richness of earth in diatoms, the so-called fossil earth of Nice (but which we suppose to come from Sicily) contains some 95 per cent. diatoms to 5 per cent. of waste matter. If we speak from the point of view of the diversity of forms, the deposit of the fresh-water Loch Kinnord, in Scotland, is the best, as it contains 200 different species according to the list published by the Rev. Geo. Davidson, while the richest deposit of marine forms is that of Sendai, Japan, which has furnished us more than 400 species.

M. J. TEMPERE, Paris, France.

RECENT PUBLICATIONS.

American Monthly Microscopical Journal for March. Washington, D. C.

The following is a brief synopsis of the contents: Professor Osborn gives a biological description of certain common hydroid animals. It is an exhaustive and valuable paper. Explicit directions are given for studying the Hydra. The article is accompanied by a finely-executed plate, with explanation of the figures.

Rev. F. B. Carter gives a continuation of an exhaustive treatise on the Radiolaria. Next is an examination of terrace-dust from Calcutta, India, with description of some magnetic and hyaline spherules found therein, with cuts and explanations of same.

Microscopical technique applied to Histology. A continuation of this valuable article, with a great many explicit directions for manipulations.

Dr. Schneider, a new contributor, writes on the Contractile Vesicle of Paramæcium. This is a fine article, with cut of *Paramæcium aurelia*.

Dr. Gray writes upon the spiracles of the click-beetle (with cut).

The editorials are upon scientific names and upon newspaper trash. A note upon terrace-dust suggests a chance for amateurs to do some scientific investigation.

A wash-bottle for sections and a convenient life-slide that can be made in five minutes are illustrated and described.

Two methods are given for detecting Tubercle bacilli in milk. Explicit directions are also given upon how to mount fish-scales. Under Diatoms we have an account of Moller's test plates.

Reports of Microscopical Societies always contain valuable information, such as abstract of papers read, etc.

Two new publications upon microscopical subjects are reviewed. Titles of microscopical publications are given to be used in forming a card catalogue. This is a new feature which promises to be of value.

THE MICROSCOPE.

——[JUNE, 1893.]——

NUMBER 6..... NEW SERIES.

MICROSCOPY IN INDIANA.

BY A. W. BRAYTON, M. D., INDIANAPOLIS, INDIANA.

The American Microscopical Society was organized and held its first meeting here in 1879. The old Indianapolis Microscopical Society held its last meeting, I think, the same year. The use of the microscope has increased yearly in our city and State since that time, but there is no society; the reason, I think, is that all interested in work now do it alone at home. I have sold, mainly as agent for Bausch & Lomb, or for Mr. Griffith when his stand was made by them, nearly $3,000 worth of stands and accessory apparatus to physicians in this city and vicinity. We have several biological laboratories in the State. Notable work has been done by Professor John M. Coulter, mainly in the years from 1880 to 1892, at Wabash College, in botanical histology and physiology. Also, since 1885, in Purdue University, by President Coulter's brother, Professor Stanley M. Coulter, in general biology; to say nothing of the work of Professor C. R. Barnes and Professor Arthur. The substantial contributions of these scientists to botany are well known the world over.

A very considerable impulse was given to embryological research in the State University at Bloomington by Professor Kingsley, formerly associate editor of the *American Naturalist.* Unfortunately for biological research in this State, Professor Kingsley only remained two years at the university. One of his most assiduous students was Dr. Robert Hessler, now demonstrator of pathology at the Indiana Medical College. His series of slides, over 3,000 in number, covers nearly the whole range of human pathology, and is one of the most valuable in the West. His knowledge of analine stains is perfect, and his preparations are very fine. Associated, also, with the work in that college is Professor Theodore Potter, professor of bacteriology. He has given a great impulse to

the study of the infectious diseases, among our medical men. The college has eighteen Bausch & Lomb stands with 3-4 and 1-6 objectives, and we are now training our students in (1) use of microscope, (2) normal histology, (3) pathology, and (4) bacteriology.

Among the notable collections of miscellaneous microscopic objects is that of Dr. Edward F. Hodges, especially rich in rare slides of Dalland, and containing the best work of that late enthusiast in diatom mounting; also, that of Dr. Frisbie Newcomer, who was a most faithful attendant of the American Association meetings up to the time of his lamented death. I am told by Mr. E. H. Griffith that Dr. Hodge's collection is the most valuable that it has been his privilege to examine.

Researches on the pathology of the nervous system have been made during the last ten years by Dr. W. B. Fletcher, the well-known alienist and neurologist, assisted by Dr. Mary E. Spink. Dr. Fletcher was the pioneer of microscope work at Indianapolis. Dr. Joseph Stillson has charge of microscopy in the College of Physicians and Surgeons of this city, where they have six of Griffith's outfits. Dr. Stillson has applied the microscope to general physiology and to his own special field, the eye. The City Hospital has an outfit costing $200, used in pathological research. The city High School has a dozen compound glasses, and uses them in laboratory work in the junior year.

Professor O. P. Hay, the well-known herpetologist, popularized the use of the microscope in biology in Butler University at Irvington, two miles east of Indianapolis, where, for ten years, he was the leading man, and an ornament to the faculty of that institution. Excellent working outfits are possessed in our city by the following physicians: Guido Bell, A. W. Brayton, S. E. Earp, E. S. Elder, F. C. Ferguson, W. B. Fletcher, J. W. Hervey, Robert Hessler, E. F. Hodges, H. Jameson, J. W. Marsee, F. A. Morrison, P. T. McShane, J. H. Oliver, H. O. Pantzer, Theodore Potter, G. W. Sloan, Sarah Stockton, W. H. Wishard, J. A. Latchiffe, Joseph Eastman, F. C. Woodburn, and of course, some few others whose possession of glasses I am not aware of. Several colleges, as Earlham, Hanover and Moore's Hill, have laboratory outfits, but which, as far as I know, have done no work known to the world, such as has been done by Professor Jordan, the eminent icthyologist, now president of Leland Stanford, Jr., University; President John M. Coulter, first of American systematic botanists, now president of our State University, and president-elect of Lake Forest University, Illinois; — by Professors Bowes, Arthur, [illegible]ley, Coulter, Kingsley and others.

My own impression is that the balmy days of microscopical societies have been merged in general biological and other scientific societies. The glass is, after all, only an instrument; it is, particularly in medicine, a means and not an end. We do not have any telescope societies that I am aware of, but astronomy is none the less a progressive science. And so with the microscope, at least with us in Indianapolis, the parent home of the national society. We are more and more interested in biology and pathology, but the day of the glass and brass men has gone into the past—has become, in brief, ancient history.

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INSTRUMENTS DESCRIBED—III.

BY THE MAKER.

THE STAR MICROSCOPE.—Messrs. Williams, Brown & Earle of Philadelphia, recommend their Star Microscope, which has fine and coarse adjustments, 1-inch eyepiece, 1-inch objective, a double mirror and diaphragm, and sells at $20. The same stand, fitted with an additional objective (1-4 inch), costs $27.50. This instrument is made by R. & J. Beck, of London, and pays a duty of 40 per cent. It nevertheless sells at about the same price as domestic instruments of the same grade. The objective and eyepiece are the same as furnished with higher grade instruments. To the substage can be fitted all ordinary accessories like condenser, polariscope and illuminator. The base is filled with lead, and the stand not likely to be overturned by accident. Great delicacy of focusing is claimed for this instrument, and its fine adjustment doubtless makes it somewhat superior to all which lack a fine adjustment.

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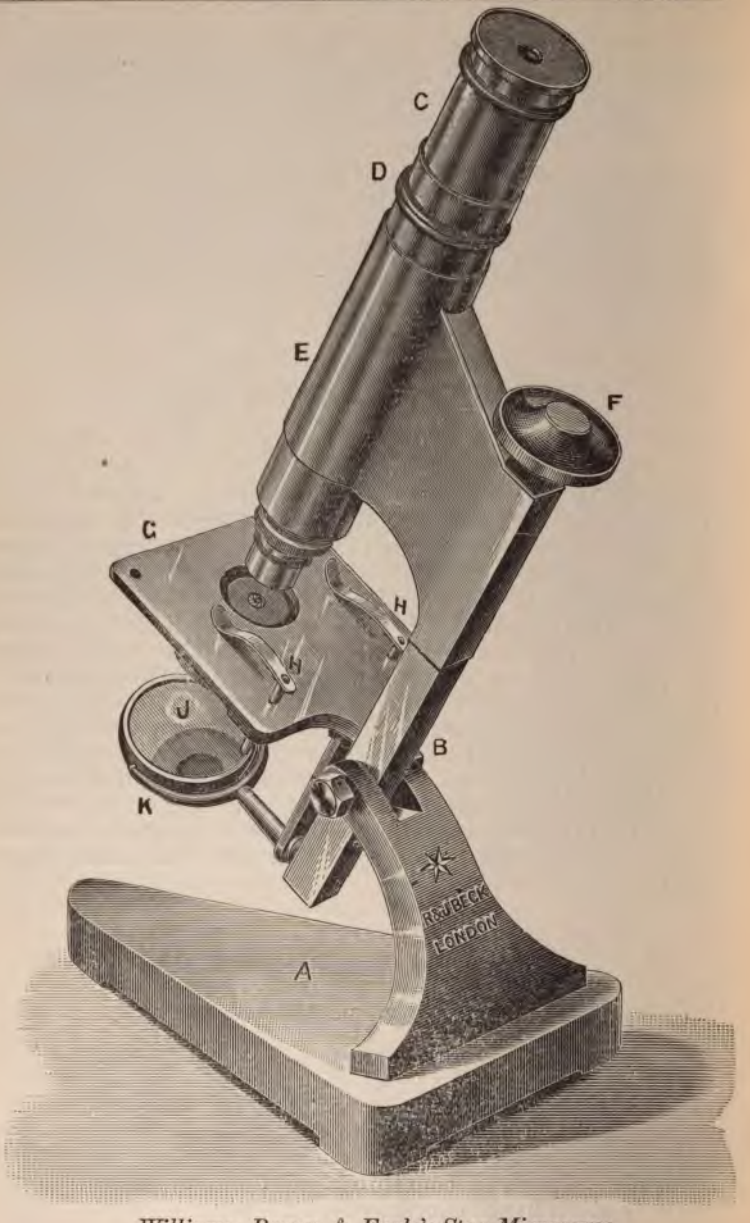
THE ADULTERATION OF DRUGS.

BY W. G. TUCKER, M. D., ALBANY, NEW YORK.

The result of a careful examination of 326 samples of various drugs was as follows: Good quality, 140, or 43.0 per cent.; fair quality, 44, or 13.3 per cent.; inferior, 79, or 24.2 per cent.; not as called for, 53, or 19.3 per cent. The latter 63 samples, designated "not as called for," show simply the fairness of the examiner, as, while containing adulterants, benefit of the doubt is given to the compounder or seller.



Williams, Brown & Earle's Star Microscope.

THE MICROSCOPE'S CONTRIBUTION TO THE PHYSICAL HISTORY OF THE EARTH.

Professor T. G. Bonney, in the Rede lectures, takes for his text the progress in geological research which has been directly due to the revelations of the microscope. By the side of the epoch-making discoveries of Darwin and Wallace, Bunsen and Kirchoff, he places the work in a humbler and more limited sphere, of Sorby, who, in 1856, first described the results of microscopic investigations into the structure of minerals and rocks. The method employed by Sorby was, strictly speaking, not novel, for, years before, in 1827, William Nicoll, of Edinburgh, had made sections of fossil wood sufficiently thin for microscopical examination. The device, however, had not been generally applied, and to Sorby is due the credit of first pointing out its wide possibilities.

Before telling the story of microscopical research into the history of the earth's crust, the author indicates briefly the mode in which the microscope is used in the examination of minerals and rocks. Slices are first cut by the lapidary's wheel thin enough for most of the minerals to become translucent, if not transparent. These are then examined under a microscope of special construction, furnished with Nicol's prisms and other optical appliances. Upon the history of the two main groups of rocks the microscope has thrown much light. For the igneous rocks it has simplified the classification and determined the mutual relations, while for the sedimentary group it has shown the true nature of their constituents and pointed out the sources from which they were derived. But it is in helping to elucidate the problem of the metamorphic rocks, of which much less was known, that the microscope has been of the most service.

The author deals at length with this portion of his subject, and shows how the microscope has assisted in the attempt to determine the history and mutual relation of these rocks. One of the most important results within the last few years has been the demonstration that without exception these crystalline schists are very old, all probably older than the first rocks in which traces of life have been found. The conclusion at present arrived at is that "the environment necessary for changing an ordinary sediment into a crystalline schist existed generally only in the earliest ages, and but very rarely and locally, if ever, since Palaeozoic time began."

The crystalline schists, then, are the relics still preserved to

us, of the early days of this earth's history, when the temperature near the surface was still very high. Since that time the zone for marked mineralogical changes has been continually sinking until at the present day it has reached a depth practically unattainable. "The subterranean laboratory still exists, but the way to it was virtually closed at a comparatively early period in the earth's history."

In conclusion the author considers that the progress made since the microscope was pressed into the service of geology augurs well for the future, and inspires the hope that we shall at least learn something of the history of the earliest ages, "when the earth had but lately ceased to glow, and when the mystery of life began."—*Jour. R. M. S.*

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A NEW MACHINE FOR CUTTING AND GRINDING THIN SECTIONS OF ROCK AND MINERAL.

BY GEORGE H. WILLIAMS, BALTIMORE, MD.

A brief description of a new machine for cutting and grinding rock sections in which electricity furnishes an economical and satisfactory motive power, may prove acceptable to the constantly increasing number of workers in mineralogy and petrography. This machine was devised for the petrographical laboratory of the Johns Hopkins University over a year ago, and since then it has been in more or less constant use.

It has thoroughly established its reputation for accurate and rapid work, while experience has suggested some improvement on the original model.

The machine consists of a substantial table carrying in its lower part the electric batteries and motor, while upon its upper surface is placed the apparatus for grinding and sawing. The table is approximately three and one-half feet square and two feet nine inches high. It is constructed, with all of its appurtenances, by the Donaldson-Macrae Electric Company (of 215 No. Calvert Street, Baltimore), whose storage batteries and electric motors are well known. The price of the machine complete is $130, consisting of the following parts: 1. Three 200-Ampere hour storage batteries, 13 inches high, in portable rubber cases. These batteries stand on a firmly-constructed cross-piece from which they may be readily removed for recharging. 2. One one-eighth horse-power electric motor of the Donaldson-Macrae pattern. This is fastened to a second

cross-piece above the batteries and below the table surface. It is provided with two pulleys from which belts pass to the shaft on the table, which carry the grinding disks and diamond saw. The grinding apparatus consists of two circular disks of solid copper 9 inches in diameter and three-eighths of an inch thick, which may be used alternately as different grades of emery are required. They are attached either by a screw or square socket to a vertical iron spindle which revolves smoothly in a conical bearing. The grinding disk is surrounded when in use by a large cylindrical pan of tin which has an opening in its centre to allow of the passage of the spindle. 4. The sawing apparatus consists of a horizontal counter-shaft placed on a different part of the table from the grinding disk and connected with the moter by a separate belt. It carries at one end a vertical wheel of solid emery and at the other an attachment, level-table and guide for the diamond saw. A small water can and spout are suspended over the level-table to keep the edge of the saw wet when it is in use.

Under some circumstances it may be found advantageous to obtain electricity for this motor by a direct wire from an electric light or power company. Considerable inquiry has shown, however, that in Baltimore the storage batteries are more convenient, safe and economical; a single charge lasts for the needs of a laboratory of ten students for a month. The batteries are removed by the electric company, and returned with little or no delay, at a cost of $3.75 for recharging.—*American Journal of Science.*

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SECTION OF RUTABAGA TURNIP.

[*From Note-Book P, of the American Postal Microscopical Club*]

BY R. H. WARD, M. D., TROY, N. Y.

This is a mass of nearly simple cellular tissue, though formed from the layers which usually produce wood, having no function but to be gorged with food-prodncts for the future use of the plant or of its cultivator. Some of the stained nuclei show in front view as roundish discs, and others, in edge view, as lenticular thickenings of the vertical cell-walls. The absence of starch from the cells of this parenchyma is a notable contrast to its abundance in most tubers, root-stocks, etc., while

the excessive proportion of water (some 92 per cent.) in the fresh turnip, which is so obvious when it is cooked for food, may further account for the exceptionally empty appearance of these cells.

There are a few wretched fibro-vascular bundles sprawling through it at the extraordinary intervals of two or three mm. apart, the fibres which would commonly suffice for a small fibrous root being here almost lost in an enormous overgrowth of pith-like tissue. One of the bundles happens to be cut longitudinally for some distance, giving pretty glimpses of reticulated vessels.

This monotonous mass gives a key to one of the most extreme instances known to economic botany, of specialization produced by cultivation.

The turnips (*Brassica campestris*, *L.*), including the Swedish turnips, or rutabagas, must have been originally weedy plants of the cruciferous (mustard) family, and one variety of the same species (?); colza, or rape seed, still remains near the wild state, with a small annual root, after much cultivation for its oily seeds. They are most nearly related to the slender mustards, of pungent seeds, and to the overgrown cabbages which, like themselves, mostly run to an excessive storing of food, but in the leaves instead of the stem—only one of them, the kohlrabi, storing no small part in a turnip-like thickening of its clumsy stem. All these forms must have diverged from a common type, at no very distant time, geologically speaking, and their assignment to (our) varieties, species, and even genera, is necessarily uncertain, changeable and unsatisfactory.

The " turnip " or " turnip-root " of the gardeners is a combination, the bottom being evidently root, and the top as plainly stem, but both are so deformed into a simple lump of stored food, that it is often impossible to see, with or without the microscope, where one ends and the other begins. Probably no one could say, from this specimen, whether it was root or stem. It is, both histologically and mechanically, as poorly adapted to either as is compatible with keeping the plant together for a year and a-half. Beyond this limit everything is sacrificed to the rapid and economical storing of food. Nor is it any longer a storing for next summer's use of the plant, in producing a vast crop of flowers and seeds, for the development has been forced by cultivation to a degree far beyond that which is useful or safe for the plant, even under the most favorable natural conditions; but to the farmer, instead, when protected by his fostering care, it furnishes a greater amount of food for man and beast than can be got from

the same amount of ground, and at the same cost of labor, in almost any other way.

Such excessively high-bred varieties are, of course, very sensitive to surrounding influences. They thrive best in light, rich, loamy soils, and in moist, equable climates, as notably in some portions of England. In poor soils they speedily degenerate into a weedy and acrid state; while liberal use of suitable manures has been known to raise their yield from two up to twelve tons per acre. They are, likewise, comparatively helpless against foreign attacks, becoming the easy prey of the turnip-fly and beetle; whole fields being often blighted, almost at once, by mildew fungi (*Peronospora parasitica* and *Oidium balsamii*). Nearly all these points will be found explained, or at least hinted, in the very simple object on the slide.

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ON ILLUMINATION FOR PHOTOMICROGRAPHY.

BY F. W. MILLS, HUDDERSFIELD, ENGLAND.

The Author of an "Introduction to the Study of the Diatomaceæ."

From "Photography Applied to the Microscope."

The illuminant may be either (1) oxy-hydrogen lime-light, (2) coal gas, (3) paraffin, or (4) day light. The oxy-hydrogen light is probably the most convenient for the majority of workers, two forms of jet being available, (1) the "blow-through," (2) the mixing jet. The former is the safest for beginners to work with, the oxygen gas being blown through a hydrogen flame upon the lime cylinder, but the light is not so good as that obtained from the latter, in which the oxygen and hydrogen are mixed in a chamber, previous to consumption at the nozzle. The nozzle of this jet should be fine in bore, rather finer than when for use in the lantern; by this means a nearer approach is obtained to the theoretical "point of light." A very good mixing jet, invented by Mr. Andrew Pringle, is provided with a special cut-off tap which, in one movement, cuts the oxygen off completely, and turns, at the same time, the hydrogen down to a minimum. The limes should be of the hardest description. All good jets are provided with an arrangement for turning the limes when they become pitted, for if their use be continued in this state, the flame is liable to spurt sideways, and so crack the condenser. The gas for the jet can be obtained compressed in steel cylinders.

In our own case we use the oxygen from a cylinder provided

with a regulator which renders the adjustment of the flame possible at the taps of the burner; but take the hydrogen from the mains—or rather, we ought to say, we use coal gas for hydrogen—the only danger in this method of working is that the oxygen must be turned on carefully, as otherwise it may be blown round into the mains, and thus extinguish the light at the jet, and form, into the bargain, a pleasant surprise for the next person who attempts to light the gas in another part of the house; but with care this cannot happen. Using ordinary coal gas alone as an illuminant, we have used an Argand burner with fair success, but found it not so good as a Welsbach flame, which is a Bunsen flame playing upon the interior of a cap made of cotton fibre netted and coated with a mixture of metallic salts, chiefly oxide of zirconium. We have also at a press used a common fish-tail burner screwed into the position of the nozzle of the mixing jet. this device being used when we ran short of oxygen, but it is difficult, by this means, to obtain a good enough light to work with any but very low powers.

An ordinary paraffin microscope lamp is also available, but is better suited for low powers than high.

Day light requires special arrangements scarcely within the reach of ordinary amateurs; a heliostat is needed to keep the sunlight upon the condensers. The heat from this illuminant must be cut off by using ammonio-sulphate of copper cell.

In our our own practice we use a four-inch condenser, out of an optical lantern, to collect the rays from the source of illumination, and so arrange it that it throws a converging pencil of rays, the apex of this cone being in the diaphragm of the microscope. When colored screens are used, they are placed between the light and this four-inch condenser, this position having two advantages which are, (1) small imperfections in the glass are of no consequence, (2) and if the flame should spurt sideways it is better to lose this glass than an expensive condenser. In order to do away with vibration of passing traffic, etc., being transmitted to the instrument, we place it on two rolls of cotton wool, one supporting each end of the microscope board.

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PRIZES TO BE AWARDED FOR ORIGINAL WORK WITH THE MICROSCOPE.

The following sums of money have been placed at the disposal of the American Microscopical Society, to be given

as prizes for the encouragement of microscopical research, and Professors S. H. Gage, D. S. Kellicott and W. H. Seaman, were appointed a committee to prepare the conditions on wnich they should be granted. The competition is open to members of the society, and to those who make application for membership before submitting their papers to the committee.

1 and 2, — Two Prizes of $50 each.
3 and 4, — Two Prizes of $30 each.
5 and 6, — Two Prizes of $25 each.
7 and 8, — Two Prizes of $15 each.

The committee have prescribed the following conditions:—

1. One prize of $50 for the best paper which shall give the results of an original investigation relating to animal life, made with the microscope, and of not less than 3000 words in length. The methods by which the results were obtained to be given in full.

2. One prize of $50 for the best paper which shall give the results of an original investigation made with the microscope, and relating to plant life, of not less than 3,000 words in length. The methods by which the results were obtained to be given in full.

3. 4. Two prizes of $25 each, for the second best papers on animal and plant life, respectively, upon the above conditions.

The papers, drawings, and speciments entered for the above prizes to be submitted to the committee on or before July 1, 1893, and the papers and drawings to be published in the proceedings.

5. One prize of $30 for the best six photomicrographs on some subject in animal or vegetable histology, whose structural features are to be illustrated by the photomicrographs of the following amplification, viz., 50, 150 and 500; two each. These are to be made by transmitted light, printed on albumen paper, from untouched negatives, which, with the specimens from which they are made, are to be submitted with the pictures to the committee.

6. One prize of $30 for the best collection of six mounted slides illustrating some one biological subject. These slides must be accompanied with a full description of the method of preparation of the specimens.

7 and 8. Two prizes of $15 each for the second-best collection of photomicrographs and slides, respectively, on the conditions above stated.

CAMERA LUCIDA AND NEUTRAL TINT REFLECTOR.

BY ALBERT SCHNEIDER, M.D., MINNEAPOLIS, MINN.

From Primary Microscopy and Biology.

Camera Lucida (Latin, camera an arched roof, and lucida bright). The student should always delineate objects under examination. The image is thereby more firmly fixed in his mind; besides, it teaches him to observe more closely. He will be surprised to find that he observes things which he would not have noticed otherwise. The camera lucida and neutral tint reflector are contrivances used with the microscope in drawing images of objects under examination. The student of average ability can construct the neutral tint reflector for himself.

Take an ordinary cover glass, incline it 45° to the eye lens of the ocular, so that the centre of cover glass and centre of eyepiece will coincide; fasten it in its place by some contrivance. Now, incline the tube of the microscope till it is at right angles to the pillar. The cover glass will refract the image at right angles. The eye, looking down through the centre of the cover glass, will see the image projected on a paper placed below on the table. The position of the light and mirror must be changed to produce the proper illumination. Be careful to avoid too much light where you are going to draw. A prime object in drawing is to produce exact representations. Students should use paper ruled into squares. Place a cover glass ruled in squares on the diaphragm of the ocular; this projects the image of the squares with the image of the object. By this means very exact work can be done.

Amplifications and reductions can be made at will. Cut off most of the light from the paper on which the image is projected, so that it will appear in clearer outlines. Get a good, sharp, lead pencil, and trace the outline of the image on the ruled paper. It is well to use a tinted cover glass, as it gives a better defined image. The student will be surprise to find what he can accomplish by this simple means. The camera lucida consists of a prism, and is used in the same manner as the tint reflector.

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TAKING CARE OF A MICROSCOPE.

When through using the microscope, separate the various parts as much as is necessary, and wipe them perfectly clean and dry. with a silk handkerchief or piece of chamois skin.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

FLIES AND THE CHOLERA.—It has been found that flies convey contagion. An investigator has fed them on broth infected with cholera dejecta, and found that the flies emitted foecal matter loaded with active cholera microbes. Also, that for three days after their diet had been changed to sterilized broth, the cholera microbes continued to be ejected. It is not safe to permit flies in kitchens or in dining rooms. Inasmuch as flies are much more abundant in Washington than in Paris, it is probable that the cholera, once here, will make far greater ravages than in Paris.

THE SOCIETY PRIZES.—We desire to call attention to the list of prizes enumerated on a preceding page. Should it be found that this year does not furnish sufficient time for good results, we presume the offer will be renewed for another year. All photographs and mounted slides for which prizes are given, are to become the property of the society. The object of these prizes is to stimulate and encourage original investigation, by the aid of the microscope, in the biology of North America; and while the competition is open to all, it is especially commended to advanced students in biology, in such of our universities and colleges as furnish opportunity for suitable work. If additional information is desired it may be obtained of the committee on prizes.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

158. *What is "Gage's" method for staining blood corpuscles?* —*Novice.*

The following is Professor Gage's method: Three or four drops of fresh blood are allowed to fall into 10 c.c. of a ¾ per cent. solution of salt in water, and well stirred to separate the corpuscles; add 100 c.c. of a saturated solution of picric acid in water, constantly stirring; allow the corpuscles to settle, pour off the liquid, add an equal quantity of the salt solution, settle, decant again, and repeat this washing until the salt solution is but faintly tinged with the picric acid; decant at last as completely as possible; add 10 c.c. of a mixture of 5 parts of Frey's carmine and 95 parts of picro-carmine solution, or the picro-carmine solution alone, and stain 1 to 15 hours. Examine a drop occasionally, when sufficiently stained, settle, pour away the staining fluid, and add 10 to 15 c.c. of a mixture of glycerine, 100 c.c., and acetic acid 1 c.c. Preserve and mount in this last fluid.

159. *What is the nature of the pygidium of a flea, referred to in catalogues as a test-object?—P. W. G.*

The pygidium is an oval-shaped organ on the last abdominal segment of the flea; there are about twenty-six disks, each exhibiting a long, central filament, and between the disks are many minute bulbed bristles. These filaments and bristles are the particular test-objects to be observed. They vary in appearance, according to the illumination. The pygidium is supposed to serve the flea as an organ of hearing. It is no longer used as a test, having been supplanted by other objects of more uniform structure and appearance.

160. *Can you give a complete formula for an amateur to try in making Farrant's solution?—S.*

Boil an excess of arsenous acid (white arsenic) in water to make a saturated solution; cool and filter. To 4 ozs. of this solution add 4 ozs. of picked gum arabic, and let it dissolve completely in the cold. Then add 4 ozs. of pure glycerine.

Mix thoroughly; strain through a well-boiled silk cloth (say an old handkerchief) in this manner: Pour 4 or 5 ounces of the thick solution in the centre of the cloth, gather up the corners and sides, and twist them together so as to confine the liquid in the centre. Then twist carefully to make a pressure on the globular fluid mass, and force it through the cloth; allow it to fall, in large drops, into the stock bottle. Some two or three ounces may be secured from the above amount, but this will last a long time. Pharmacists have other and better methods of filtering gelatinous fluids. The above method was used by the writer, and produced a clear, permanent article. Amateurs and others, whose time is worth about 50 cents a day, may try the above formula.

PRACTICAL SUGGESTIONS.

To Cement Wood to Glass.—Gum some labels of paper to the glass. If properly dried, nothing but scraping or soaking will remove them. Then cement the wood to the paper, using —virgin rubber, 2 parts; resin, 1 part; gum shellac, 2 parts. Melt together and apply hot.—*Sci. American.*

To Bore Holes in Glass.—Break off a part of the tip of a three-cornered file, and grind a triangular point upon it. Avoid heating it enough to injure the temper; then make your holes in it just as you would make holes in wood, with an awl, using turpentine to moisten the bearings of the glass. The edges of the file can be sharpened with an oil stone.—*Sci. American.*

Pharmaceutical Study.—At the Trinity University, Toronto, a school of pharmacy has just been established, and in order to receive the degree of Phar. B. the candidate must pass an examination in "botany, including microscopy." For the degree of Phar. D. his advanced botanical work must include either classification or bacteriology.

Radam Microbe Killer.—In an advertisement contained in the *Canadian Pharmaceutical Journal* for May, 1893, Wm. Radman informs the public that "our rates allow the retail trade to make from 45 per cent. upwards on sales," and that "druggists will be surprised at the sales they will make when once they have the microbe killer in stock."

CORRESPONDENCE.

FARRANT'S MEDIUM.

I found Carpenter's recipe in Thomas Davies' "Preparation and Mounting of Microscopic Objects" about thirteen years ago, and a druggist prepared for me about a pint of the solution. I work with it yet, though I am sometimes troubled with air bubbles, but it is not my favorite medium. I find that when it is overcharged with camphor, crystals will form in the mounts. These are very troublesome with polarized light. At that time fluids could not be sent by mail, and, not wishing to pay express charges on the solution, I had it made at home. I do not think that there is ground for complaining about the prices of microscopical appliances. The instruments will last for a lifetime, and an ounce of any solution lasts, also, a long time. Then, the sale of these things must be very slow; if salt and sugar were used as sparingly as microscopical apparatus, I think they would be quite as expensive.—P. W. G.

RECENT PUBLICATIONS.

The Birds of Montreal. By Ernest D. Wintle. Montreal, 1893. Price. $1.00.

This is a special study of the birds frequenting the island of Montreal. The list is believed to be a correct and complete one of all the species of birds occurring in the district. The work describes 251 species and subspecies of birds, with notes on each as to whether they are "permanent residents," or those that are found regularly throughout the year; "winter visitants" or those that occur only during the winter season, passing north in the spring; "transient visitants," or those that occur only during the migrations in spring and autumn; "summer residents," or those that are known to breed, but which depart southward before winter, and "accidental visitors" or stragglers from remote districts; giving their relative abundance, as to whether they are rare, scarce, common or abundant, data of nests and eggs when found, and especially noting the species that breed in the city and Mount Royal Park; also, data of migratory arrivals and departures, and other notes, all of which are deduced from original observations made during the past ten years. Orders may be sent to us.

THE MICROSCOPE.

JULY, 1893.

NUMBER 7. NEW SERIES.

THE GROWTH OF MICROSCOPY AND OPPORTUNITIES OFFERED BY IT TO EARNEST STUDENTS.

BY M. I. CROSS, LONDON, ENGLAND.

(From Introduction to Modern Microscopy, London, 1893.)

The history of the development of the microsope is exceedingly interesting, and itself would fill a small volume: suffice it to say that it was but sixty-eight years ago, or in 1824, that Tully made the first achromatic microscope. Since that time, step by step, such progress has been made in its construction as would be scarcely realizable to those who have not followed it. Ten years ago the President of the American Society of Microscopists, in his annual address, remarked that lenses which were believed to have so nearly reached the limit of perfection fifteen years ago are antiquated now and the theoretical limit of perfection has moved forward like the horizon and is as far off as ever." The same statement applies to-day, and even within the last five years, lenses have been placed at our disposal by the leading opticians giving results that our microscopical predecessors of fifteen or twenty years ago would never have dreamed of; and still further experiments are going forward, with the view of giving greater advantage in microscopical research. What has been done in the lens parts of the microscope has also been effected in the mechanical, and a far better microscope can be purchased to-day for a given sum than a few years ago could be obtained at nearly double the cost, bringing that which was a luxury, and acquirable only by the wealthy, within the reach of the slenderest purse. This is

largely due to the work of enthusiastic amateurs. At leading microscopical societies, notably the Royal Microscopical Society and the Quekett Club, which meet in London, are to be found men whose recreation is in the microscope, and whose suggestions, as the result of personal practical experience and research, are of such weight and value that manufacturers, rivalling one another, have taken advantage of the ideas of these workers. Also in the medical world its advantages have become appreciated, and necessitated the introduction of reliable and high class instruments at a moderate price. Not many years ago a hospital rarely possessed more than one or two microscopes, and these were generally kept under a glass shade, more for ornament than use; but to-day every student has to provide himself with one, and become practically acquainted with the ultimate structure of every organ and tissue both in health and disease. The chemist finds it indispensable, and our medical officers of health employ it for detecting adulterations, entozoa, etc. So that not only is it one of the most intelligent means of recreation, but it is also invaluable in many duties affecting our immediate comfort and welfare.

The demand for microscopes caused by their large employment by professional men and students has caused a corresponding competition among manufacturers to produce the best possible instruments at the lowest price, suitable for the purposes for which they were required, and this has been an important factor in the present state of good quality at low cost.

Some people hesitate in taking up the microscope at all, not caring to use it merely as an amusement, and thinking that they have no special genius for science, or that the ground has been gone over so repeatedly that there are no new worlds to conquer, and that it is perfectly hopeless for then to discover any new organism, or for any novel idea to cross their minds. This is quite a mistake, and it will surprise any microscopist who uses his instrument thoughtfully how love for the work will grow upon him and how gradually he will become master of some special line which he has adopted as his own. On this point we would echo the words of a well-known microscopist. "It needs no marvellous intellect, no special brilliancy, to ceed in a scientific study: work at it ardently and persever- and success will follow."

CHOLERA: ITS PREVENTION AND TREATMENT.

BY ELMER LEE, M. D. CHICAGO, ILL.

A mass meeting of physicians for the consideration of the above subject was recently held at the Great Northern Hotel, under the auspices of the Practitioners' Club of Chicago, and the following paper was read.

The leading propositions suggested and tried in the treatment of Asiatic cholera during the epidemic of 1892 in Europe consisted of the following general plans. Early in the epidemic, lactic acid treatment was proposed on the ground that it would neutralize the alkaline accumulations in the bowels and so stop the multiplication of the bacilli.

An Englishman residing in Paris considered cholera a hyperaemia of the spinal cord. His prescription was ice poultices continuously applied to the region of the whole spinal column. A small pamphlet was published by the doctor in defense of his conclusions and to present testimonials in favor of his congestion-theory. As this system of management was not seriously considered by cholera physicians its efficacy cannot be stated.

The use of large doses of the Russian remedy, salol, the invention of Prof. Nenski, of St. Petersburg, grew in favor as a new remedy during the epidemic. The average result of cases so treated in St. Petersburg, and by my American colleague, Blackstein, in Baku, and in other provinces in Southern Russia, could not be said to be satisfactory. Finally, at the last of the epidemic, its influences had come to be considered less and less valuable—this, however, can be said—it was in all and all more largely used than any other new remedy. Still it would not be safe to place too much trust in it.

Calomel was everywhere a remedy even more used than salol. Formerly this drug was used in very large doses, but last year it was the very small doses which found favor. Especially was this true in the treatment of cholera in Hamburg.

Of the surgical measures, the infusion of solutions of salt were most practiced. The solution consisted of distilled water in which was dissolved one half of one per cent. of common salt. This liquid was warmed to the temperature of the blood and either introduced directly into some large vein or injected

with a long needle and a large barrel syringe beneath the integument of the abdomen. The amount of salt solution used in either case would be from one pint to one quart each time. In one case treated at Hamburg as much as thirteen quarts of salt-water were used from first to last. The patient recovered. The subcutaneous injections were frequently followed by cysts and sometimes abscesses appeared. Intravenous injections sometimes proved a godsend, but more frequently disappointment could be said to be the result. These injections were only used in the third period of the disease or the stage of collapse, algidity or asphyxiation, at which period it would be rather unreasonable to expect recovery by virtue of any treatment.

The Italian treatment, as it was called in Russia, was much used and with frequent gratifying success. This practice was introduced by Prof. Cantani. It consists of a clyster composed of the following constituents:

Boiled water or infusion of chamomile, (warm) 2 litres.
Tannin, 5 to 10 grams.
Laudanum, 30 to 50 drops.
Powdered gum-arabic, 50 grams.

This or some part of the solution is occasionally passed into the rectum, to be retained if possible by the patient. In the experience of those who have followed this method of treatment almost every case taken at the beginning of the disease has lived. It is certainly more reasonable in principle than simple medical management.

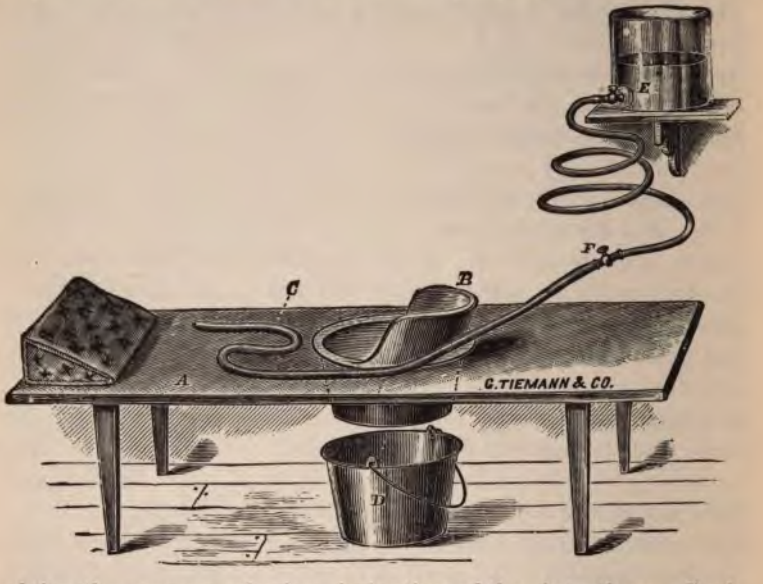
Of the experiments of Ferran, of Spain, and Haffkine of the Pasteur Institute, much has been said, but what has been said has failed to bring conviction to my mind. As cholera itself cannot be said to protect one who has had the disease, and recovered, against a second attack, then that which is less than cholera in influence cannot be expected to do it. The seat of the disease is located in the intestines, and, so long as the infectious juices are there, the lymph vessels in the processes of physiological function will continue to infect the blood. Can we hope to thwart physiological action of absorbents by hypodermic injection of cholera culture, made at some time, it may be years previous to the date of the passing epidemic?

The answer by my judgment, is that such expectations are flimsy. The caprice of Stanhope at the Hamburg Hospital cannot seriously pass for an argument in favor of anti-choleraic vaccination. His interesting but wildly exaggerated stories were the product of a newspaper's love for sensation, and profit of increased sales of newspapers.

My own personal thoughts concerning cholera and the method of treatment, as practiced by me both in Russia and at Hamburg during the epidemic of 1892, will occupy the remaining time allotted me.

It is now well known that cholera is a disease of the alimentary canal. Its inciting cause is believed to be a germ taken into that canal through the medium of food and drink. There its presence is protested against by the absorbent vessels, which eliminate from the food the nutriment for the body. The first symptom produced by foreign invasion in the intestines is a diarrhœa, which may precede vomiting from one to three or even four days. If this be true, the bowels must be the seat of disorder, and the most direct method of reaching them by medication must be the best. If the stomach could be emptied of the foul material before the poison has passed further, there might be speedy relief and, indeed, no real cholera. After it has passed into the intestines, medicine administered through the stomach may be slow in reaching the seat of the disease, and even then can only mingle with the poison, holding out the hope that the one will be neutralized by the other. This hope, in truth, is seldom realized. But if the poison can be removed from below, the course is left clear for nature to recuperate itself. The diarrhœa is an evidence of the great exertion put forth by the organism to rid itself of the death-dealing agency, and probably it would be effectual in the great majority of cases were it not that the nervous forces of the system are exhausted by the terrible strain before the required evacuation of the bowels is completed. A large irrigation of hot water, made soapy preferably by neutral liquid soap, introduced into the colon through a suitable rubber tube, is the simplest, and I am prepared to say further that it is a more satisfactory way of treating cholera than any other with which I am acquainted. The time to begin the irrigation is at the very earliest possible moment Save the blood every single moment of infection by im-

mediate action, even if there is the faintest suspicion of cholera either with or without diarrhœa. In every post-mortem seen by me of cases of death in which there had been no marked diarrhœa, the colon and small intestines were filled with accumulations of choleraic matter which swarmed with comma bacilli. The rule from which there need never be deviation is to treat the patient by irrigation of the bowels and rinsing of the stomach, without waiting for confirmation of the diagnosis either with the microscope or by the culture test. The best part of the practice is always to save the patient, even at the expense of fine statistics. The accompanying illustration ex-



plains the manner of using irrigation of the intestines. Such apparatus is suitable for places of public treatment of the sick. In private practice the syringe would take the place of the irrigating apparatus. The exact model of the irrigating table used by me in St. Petersburg may be seen at Mr. Sargent's store on Wabash avenue.

For internal treatment my experience taught me that the medicinal peroxide of hydrogen, of Marchand, given in cupful doses of the strength of 4 per cent., or even much stronger, was a better antiseptic than any other drug heretofore known in

the treatment of cholera. Then the treatment would be, first, immediate irrigations with hot water and soap using from one to three gallons at a time twice a day for the first and second days. Once a day afterwards if required, which is seldom the case. At the same time cleanse the stomach with medicinal peroxide of hydrogen and hot water used freely—by urging the patient to drink. The feeding and nursing are the same as would be required by a patient suffering from septicaemia or other prostrating disease. My belief is based upon personal experiences and the following surgical measures and medical treatment, viz: Irrigation of the bowels, always first with hot water made soapy with neutral liquid soap or a good castille soap; second, cleansing and rinsing the stomach with hot water and medicinal peroxide of hydrogen, of Marchand, continuing till it is well washed; third, food and nursing; fourth, medicinal peroxide of hydrogen of 4 per cent. strength given in cupful doses at intervals of two hours during the sickness till convalescence; fifth, meet the requirements as they come up, as would be done in any other grave disease, using whatever personal experience has taught us to believe is good. Cleanse the bowels, wash the stomach, feed the sick, keep them warm if cold, and reduce excessive heat by the cold bath rather than reliance upon drugs; using anything in an emergency that is the easiest and most accessible to procure. The cholera patient may be convalescent inside of the first few days, or if not convalescent and not dead, the case goes into the typhoid state, after which convalescenec may be deferred for several weeks or death may be the conclusion. The temperature prior to the fifth day is generally subnormal or a little above, but on the fifth day marked exacerbation and elevation of temperature indicates the typhoid condition.

INSTRUMENTS DESCRIBED—IV.

BY QUEEN & CO., PHILADELPHIA.

The Acme No. 5 Microscope.

This is an instrument of thorough construction, with adjustments smooth and perfect in action, the lenses being of especial excellence and clearness of definition.

We can reccommend this microscope to pharmacists as an efficient instrument for their requirements; also for general school use, in showing the tissues of plants, circulation of blood and multitudes of other interesting objects.

Simplicity, *strength*, and *solidity*, with low cost of construction are especially claimed for this microscope. The base is a heavy tripod, so proportioned that the microscope is very firm when vertical or inclined. The collar, in which the body tube slides, is firmly dovetailed with and screwed fast to the arm.

The mirror (concave) is of ample size and swings laterally for oblique light, or over the stage for illumination of opaque objects. A revolving diaphragm to regulate the illumination is attached beneath the stage.

By means of the draw-tube, the full English tube-length of ten inches may be obtained when desired.

The plan of constructing the fine adjustment has the following features especially fitting it for classwork in the laboratory

First (and principally). Perfection of action: the upper plate carrying the object, must respond instantly to the movement of the screw, upward by positive action, downward by the spring of the plate; and without any lateral or side motion; these, of course, are the essential features of a fine adjustment.

Second (and important). This perfect action will continue as at first; as there are no joints to wear loose or become strained, there can be developed no lost motion nor lateral motion, by wear or rough handling, all excepting the screw being made practically one piece. *Third.* It is inexpensive in construction.

(An objection is sometimes made that one side of the stage-plate is moved, while the other is not, thus elevating one side more than the other. We only ask those to whom this may appear an objection to make a practical and careful test. They will find that this objection is utterly invalid in practice, as the range of motion required is very slight; at mid-range the stage-plate is strictly horizontal.)

We can well recommend this microscope to medical students, and to physicians who may not desire to purchase a more expensive intruments, as *efficient for histological work and urinary analysis.* It has society-screw, and is furnished with1-inch and 1-5 inch objectives, and one Huyghenian eye-piece, in upright case with handle. Powers range from 40 to 350 diameters; the 1-5 inch is a lens of such good definition (and sufficient aperture) that it will resolve *P. angulatum.* Price, complete, in neat imitation mahogany case, $28.00.

Clips and Ledge.—Nearly all microscopes are provided with a pair of spring clips to hold the slide. Convenient as these generally are, they often prove a positive nuisance, especially when examining temporary mounts, by "whisking" off the cover glass at the most inopportune moment. A mere ledge, to rest the slide against, is more convenient. This can be improvised by bending a strip of thick sheet lead so as to grip the stage sufficiently firmly to prevent the sliding down of the slide when the stage is inclined, and still capable of being easily pushed up and down. (This applies only to the rectangular stages; not to the round ones).—H. M. Wilder, *in Druggist's Circular.*

A CHEAP ROCK-CUTTING MACHINE.

BY W. N. SHERMAN, M. D., MERCED, CAL.

On page 86 (June number) appears an article on a new machine for grinding and cutting mineral sections, stating that the price of the machine is $130. A description of a home-made cheap apparatus, for the same purpose may be of interest. While not so elaborate or complete, it answers an excellent purpose. Storage cells are used. These consist of four cells with five plates each, three positive and two negative. The plates are made of sheet lead one-fourth inch thick, 7 by 8 inches with perforations, one-fourth inch apart. These round holes are to be filled with the active material, composed of the red oxide of lead for the positive and the yellow oxide for the negative. The holes are threaded inside so as to firmly retain the forming paste during charge and discharge. The plates are connected together and placed in wooden cells which are lined with an acid-proof paint, and have a neat cover or lid over box, which contains all four cells. The cells are about 150 amperes each, and are connected in series so that two, three, or four cells may be used according to the power required. These cells are charged by gravity cells and are receiving a continuous current when not in use. They are connected to a low resistance motor costing $15. It is one-eighth horse power or eight volts, and runs at a rate of about 3,000 per minute. It may rest upon a table or under a table, and is connected by a round leather belt to a small jewelers' lathe, which is arranged for various wheels, for sawing, grinding or polishing. The drip cups and pans, are easily improvised by the user. These same cells can be used for various other purposes, and the motor likewise. I use them for microscope lamps, dark rooms, for surgical lamps, galvano-cautery, surgical engine, etc. The cost of maintenance does not equal that of the Electric Light Co. charges, and when not in constant use they are always fully charged. The whole apparatus may be set up at a cost not to exceed $75, and much cheaper, if cells and motor are all home-made. The motor is portable, and can be used for ventilating fan, static machine, and various other purposes. The speed is ontrolled by a home-made foot rheostat, inserted in the bat-uit. *Two* storage cells of above size furnish sufficient ll my work, in grinding and polishing.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

THE LIBBY PRISON WAR MUSEUM.—Of the many attractions outside of the World's Fair in Chicago, there are but few in which there is so much interest centered as there is in the Libby Prison War Museum. In 1889 this celebrated prison was removed from Richmond to Chicago and converted into a War Museum. The project was undertaken by a syndicate of the best-known business men of the city whose enterprise was conceived in a commercial spirit, but has attained a national reputation. A project such as this was never before heard of. To move a brick and stone building the size of Libby more than a thousand miles, across rivers and mountains, was an enterprise that many of the best known contractors in the West refused to undertake at any price. But the move was made with success. Then the famous old structure was filled with war material that represents the work of a lifetime and the expenditure of half a million dollars. The great collection is conceded to be second to none in the country and includes much of the most valuable material that the greatest civil war the world has ever known has left to posterity. The collection includes thousands and thousands of relics of every description, many of which form important links in the history of the Nation. The old building itself is fraught with interesting memories and

the story of the celebrated tunnel escape of February 9, 1864, never fails to interest the visitors. One hundred and nine Union officers made their escape through that tunnel, which formed one of the most thrilling events in the history of the war.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

161. *Give in detail the best way to imbed pathological and biological material in celloidine, so one can follow each stage. How may I overcome the "giving" of the material so as to get thin and uniform sections?—E. F. H.*

Minot's method contains all the essentials. Make two solutions of celloidine in a mixture of equal parts of absolute alcohol and ether. A thin syrupy solution for infiltrating the tissue, and a thick molasses-like solution for the proper imbedding medium. The tissue, properly hardened and dehydrated in alcohol, is placed in a mixture of equal parts of absolute alcohol and ether for 24 hours, then directly into the thinner celloidine solution for one to three days, according to the size and firmness of the specimen. Cut a flat top cork to a size to accommodate the specimen, wrap a piece of filter paper around it and fasten together with pins, the whole forming a sort of a box with a cork bottom. Wet the cork bottom with absolute alcohol, drop in some of the thick celloidine. When somewhat hardened, arrange the specimen in place. When firm enough to stand, fill the box with the thick celloidine so that it will cover the specimen about half an inch deep. The solution shrinks considerably in hardening. Allow the box and contents to stand until firm enough to hold together. A piece of lead with a pin through it may be stuck to the lower side of the cork so the whole will sink right side up, then drop it into 70 or 80 per cent alcohol. After one to three days the celloi-
ll be hard enough for cutting. Strip off the paper and

trim the mass if necessary. Strong alcohol will soften celloidine and dilute alcohol will allow it to harden. The specimen may remain in the dilute alcohol until firm enough for cutting. A sliding cut, using the whole edge of the knife, must be employed and the blade kept flooded with 50 per cent alcohol.

Celloidine cannot be cut into very thin sections, but is useful for tissues that would be injured by the heat employed in paraffine imbedding. See Am. Mo. Mic. Journal; Vol. VII, p. 229, for Minot's method in full.

162. *How shall I treat sections after staining in logwood, borax carmine and the anilines?—E. F. H.*

Logwood staining. After staining, simply wash in water containing a trace of soda (alkaline,) dehydrate in alcohol, clear with oil of cloves, drop on balsam and cover.

Borax carmine. (Must not touch water). Wash in acid alcohol, (alcohol 5, hydrochloric acid 1,) then absolute alcohol, clove oil, balsam.

Safranin. Wash in alcohol, clear in turpentine, balsam, iodine green (methyl green,) wash in water, alcohol, xylol, xylol balsam.

Methyl blue. Wash in water 100 and acetic acid 1, then absolute alcohol, cedar oil, balsam.

Carbol-fuchsin. Wash in 25 per cent solution of sulphuric acid in water, about half a minute, then in 60 per cent alcohol, then absolute alcohol, cedar oil, balsam.

Oil of origanum may be substituted for cedar oil, for clearing aniline stained sections.

163. *How is the Ehrlich-Biondi triple-stain made? How is it used for staining blood and tissues?—Leslie Whalley.*

Methyl green (Iodine green,)	½	grain	in	100	drops	of water.
Acid fuchsin,	½	"	"	40	"	" "
Aniline orange, (Safranin,)	2	"	"	200	"	" "

Mix these solutions and filter. Spread the blood on a slide, dry over a flame, stain in the above solution 10 to 15 minutes, wash carefully in water, dry, and apply xylol balsam.

For tissues, stain the section in the above solution for 12 hours, wash in water, dehydrate in absolute alcohol, clear with xylol or oil origanum, drop on xylol balsam and cover.

PRACTICAL SUGGESTIONS.

RAPID POLARIZATION—Since writing my last article on this subject (*Druggist's Circular*, June,) I have simplified the procedure still more, so as to make it more convenient. My modification can be applied to any microscope provided with a diaphragm wheel. Solder to the largest hole of the diaphragm a short tube, say three-quarters of an inch long, and fit into this tube a nicol, turning the latter so that the long diameter runs from front to back, when it is brought under the hole in the stage; the nicol is then in the best position. (An inspection of a mounted nicol, polarizer or analyzer, will show that the nicol is held in place by pieces of cork.) In polarizing, I merely revolve the diaphragm so that the nicol comes under the hole in the stage, and then clap on the tourmaline (or other nicol) over the eye-piece. There is then no need to be careful to face the light, nor to observe any particular slope of the microscope tube, and, what is better still, the illumination is a good deal brighter than with a black glass. If there is no diaphragm wheel, recourse must be had to the black glass, the illumination of which may be greatly improved, however, by super-imposing a plate of ordinary glass. The optical reasons for this improvement are somewhat obscure, a thick piece of plate glass, blackened on the reverse side, does not brighten the illumination as much as a piece of ordinary glass on top of a thin, blackened glass. Still easier, place a piece of glass (a slide, for instance) on top of a *piece* of *black* "*japanned*" tin.—*H. M. Wilder.*

CORRESPONDENCE.

THE TARIFF ON BOOKS.

In general I am opposed to any tariff except for revenue. I think I have good grounds for that position, but a discussion of them would lead too far at this time. On some articles I am opposed to any tariff whatever. Among the latter are scien tific books and educational works in general.

My reasons for so thinking are briefly stated as follows:

First; real scientific work is carried on by people who, financially speaking, belong to the middle classes. As far as my observation goes, scientific people seldom amass wealth, and many eak out only a precarious existence. Scientific pursuits and accumulation of wealth seem diametrically opposed. In view of this fact, to curtail the acquirement by this class of people of books and instruments, the forces by which they work, by increasing the cost, is to my way of thinking a little irrational.

Second; I think it is wrong to tax one class of people for the benefit of another, as in case of the protective tariff, or for the government, that is the people, to benefit in the way of a tax on the class from which it receives so many benefits directly and indirectly.

Third; I think that under the conditions of free trade, under which conditions there can be no more than healthy competition, the interests of not only the manufacturer but the consumer will be served in the very highest manner.

Within the limits of a short letter, it is impossible to offer any argument for the support of one's statements, but the above represents fairly well my position with respect to the tariff on books and microscopical instruments. I am glad you have given the microscopical people an opportunity to express themselves in this matter, and I await the publication of the results with a great deal of interest. I was very much interested in the results of the other request that you sent out as to the position of your subscribers with respect to the tariff.

C. E. Stoner, Des Moines, Iowa.

RECENT PUBLICATIONS.

First Book of Nature. By James E. Talmage. Salt Lake City, Utah. 16 mo, 306 pp. 80 cuts.

The first principles of zoology, botany, mineralogy and astronomy are here briefly outlined for use in the District Schools of Utah. Classification and technical definitions have been wisely omitted. "The writer has sought in a sincere though humble way to demonstrate that Nature is but another name

for the will of God as expressed in His works." We are sorry that he has felt called upon to do this, for it leads him into some absurdity. Speaking of the vast variety of living forms, which he says, "the Creator has placed upon the earth, each with a special purpose to meet," he remarks that "everyone is contented to live and to move within the sphere for which its Maker intended it." Elsewhere, he says: "Sharks readily attack men who may be swimming or diving in the water and are able to bite off a human leg at a single snap. Though these savage monsters are doubtless intended to be butchers and destroyers, the Creator has wisely checked their facilities for unrestricted slaughter." So, biting off a human leg occasionally is within the sphere which the Creator intended sharks to occupy! The author knows that many fishes feed upon their own young and yet he says their Maker intended such unnatural doings. Certain other forms like the seals kill their prey but eat only a small fraction of what they kill. Villainous snakes eat immense numbers of our food fishes. Certain birds destroy the eggs of others out of pure malice. If all this is being "content to live and move within the sphere for which its Maker intended it," the children will need some explanation of His intentions which is not at hand, or else they will be led to disrespect His character.

THE MICROSCOPE.

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We can furnish new subscribers with complete sets of the New Series but of the old series, there now remain only sets for 1887,'88,'99,'90,'91 *and* '92. *A few more odd Nos. will go off at the rate of* 25 *for a dollar.*

THE MICROSCOPE.

AUGUST, 1893.

NUMBER 8. NEW SERIES.

EXTRACT FROM THE PRESIDENT'S ADDRESS BEFORE THE MANCHESTER MICROSCOPICAL SOCIETY.

By J. F. GOODE,

MANCHESTER, ENGLAND.

It is very essential that those who intend making microscopical study their specialty should take means to render themselves as conversant as possible with everything that appertains to the management of the microscope. I think all will agree with me that to be able to use the instrument to full effect and gain a correct estimate of the object under examination, it is essential to know something of the laws of optic which are concerned in the production of a true microscopic image. The utilization to the full extent of the powers of the microscope can therefore, only be acquired by long and patient study of those principles on which its correct performance depends, and also on the skillful and effective manner in which the objects examined by it are prepared and mounted. It has been the aim of the sub-section to impart this knowledge and several members who are experts have been good enough to give practical demonstrations on the Friday evenings.

I should like here to refer to the new apochromatic objectives of Zeiss. These lenses have been in use some little time, but as far as I am aware, have not been exhibited nor described at any of our meetings. A special kind of glass, which possesses a wider range in refraction and dispersion than the old crown and flint glass, is used in the construction of these objectives, together with the introduction of special fluorite lenses

into the combination. By this means it is possible to entirely remove the secondary spectrum, leaving only a residuum of a tertiary character, which is got rid of by specially constructed eye-pieces, called compensating eye-pieces, the result being that images perfectly free from colour are obtained. One of the many advantages which these lenses possess is that the power can be increased by specially constructed eye-pieces to a much greater extent than is possible with the old lenses. By this means one objective can be made to do the duty of several; and the microscopist of the future will only require about three objectives to do everything he wants.

Through the courtesy of Dr. Anthony, I had an opportunity of testing the performance of two of these objectives, and comparing them with lenses of ordinary make but of very fine quality, and the result was very much in favor of the new form. Compensating eye-pieces were used with all the objectives tested as they give better results, even with objectives of the ordinary construction, than the Huyghenian form generally used. The apochromatics were tested on a variety of objects with the deepest eye-pieces, and there was not the slightest indication of their breaking down. To get a better idea of the superiority of these lenses, the objects were first of all viewed with some objectives of the old construction, but of very fine quality. These were tried with the highest eye pieces they would bear, and were very satisfactory, one very fine quarter-inch running the apochromatic of about the same power pretty close; but there was no mistaking the superiority of the latter under the deepest eye-pieces, all the minutest details coming out perfectly sharp and clear to the last. Of course, the illumination was of the best, a prism being used instead of the plain mirror, and the first-class condenser was most carefully adjusted before commencing the trial, the performance of an objective being very much improved in proportion as these details are attended to. The objectives referred to were dry lenses, and in power equivalent to an English inch and quarter-inch. Another advantage of these lenses is the large working distance, and the facility with which the magnifying power can be increased without disturbing the object under examination.

Owing to their more perfect corrections, these lenses are specially adapted for photomicrography, which is becoming more

and more indispensable as a means of scientific research. The chemically prepared film of the photographic plate is capable of recording faint markings and minute structural details, which cannot be detected in the microscopic image by the human eye, or at least very imperfectly. As an illustration of this, from an astronomical point of view, the following facts with respect to the discovery of small planetary bodies which move in orbits between those of Mars and Jupiter may be interesting:— "From observations of the first of these, Ceres, in 1801 until the end of 1891, 321 had been discovered by the comparatively laborious method of eye observation. From that time photography has been pressed into the service, and no fewer than 44 have been found within the last fifteen months. Professor Charlois, of Nice, reports the finding of six during the last week, a feat which would have been considered unparalleled at the beginning of the century." This I think conclusively proves the superiority of photography in special work of this kind. The above is only one of the many applications of photography for recording astronomical phenomena, all of which have been of great service.

It is equally applicable to microscopical investigations; and a much more correct idea of the structure or the nature of the markings in various minute organisms, has been gained by its use. than could have been arrived at by eye observation alone, notably the spendid photo-micrographs of some of the Diatomaceæ, which have been taken with the most perfect and most powerful objectives made. It is impossible to predict to what extent the aid of photography will be found useful in deciding obscure physiological questions.

Professor Exmer, of Vienna, has succeeded in taking the photomicrograph of the image which is formed at the back of the compound eye of an insect. This image he found to be precisely the same as that which would be presented at the back of the single eye of one of the higher vertebrates. As the physiology of the arthropod eye has been the subject of much discussion and diversity of opinion, this discovery may be the means of throwing a new light on the question, and, if so, it will be another of the triumphs of photography in elucidating this and similar phenomena.

DEMONSTRATING CYCLOSIS.

By R. N. REYNOLDS, M. D.,
DETROIT, MICH.

But few objects are so interesting under the instrument as the wonderful Cyclosis in *Vallisneria*. One can see the trains of green balls chasing each other around the cells, by the hour. In this cold climate, I have been unable until this year, to keep the grass through the winter. Pieces of grass with or without roots will live for some weeks in a jar of water in summer, or in a comfortably warm house in winter. After ice began to form along the edge of Detroit River last fall, I gathered some rootless pieces of *Vallisneria* also one root of the same with two blades of the grass attached. I placed the lot in a jar of water which I kept in a cold cellar changing the water once in five to ten days.

Whenever I wished to use a specimen, I broke off two bits about ⅜ or ½ inch long each from a blade of the grass. These I laid side by side in a few drops of water on a *warm* slip of glass, laid a cover-glass on and examined with 1-5 or higher objective. Usually the circulation can be seen at once; at other times it needs to have the light on it for ten or fifteen minutes in order to start it, two bits of the grass are used because one might tilt the cover-glass.

The grass on the roots died before the rootless specimens. The latter remained green and alive until February. I entertained some friends with a specimen of it on the 19th of February. If it had been kept in a warmer location, all would have been dead six or seven weeks earlier. About the end of February I noticed in the case of the specimen with roots that the fine roots and the blades of grass had rotted off the stem, leaving a green stem, of about an inch in length. This I placed in another jar of water and took it up stairs into the living rooms, where it soon sent out new shoots and from it I soon had new grass to use. Had I taken this into the warm room a few weeks earlier, as I shall do next winter, I would have had new grass before the old died. What I learned in this case is that the grass will live much longer when kept at or near freezing point than if it is kept warm; and that the stems between the fine roots and the blades of grass need to be kept in water in a warm place.

THE PRIMARY FOOD SUPPLY IS MICROSCOPIC.

By. PROF. W. K. BROOKS,

BALTIMORE, MD.

[From a memoir on the Genus Salpa.]

As the result of our review, we find that the organisms which are visible without a microscope in the water of the ocean and on the sea bottom are almost universally engaged in devouring each other, and many of them, like the blue-fish and the albacore are never satisfied with slaughter, but kill from mere sport.

Insatiable rapacity must end in extermination unless there is some unfailing supply, and as we find no visible supply in the water of the ocean, we must seek it with a microscope. By its aid we find a wonderfully rich and diversified fauna made up of innumerable larvæ of all sorts of marine animals together with a few minute and simple metazoa, but these things cannot form the food supply of the ocean. It is clear that a single carnivorous animal could not exist very long by devouring its own children, and the result must be the same however great the number of individuals or species.

The total amount of these organisms is inconsiderable, however, when compared with the abundance of a few forms of protozoa and protophytes, and both observation and deduction force us to recognize that the most important element in the total amount of marine life consists of some half a dozen types of protozoa and unicellular plants, of globigerinæ and radiolarians, and of trichodesmium, pyrocystis, protococcus, and the coccospheres, rhabdospheres and diatomes.

Modern microscopic research has shown that these simple plants; and the globigerinæ and radiolarians which feed upon them, are so abundant and prolific that they meet all the demands made upon them, and supply the food for all the animals of the ocean. This is the fundamental conception of marine biology. The basis of all the life in the modern ocean is to be sought in the micro-organisms of the surface.

This is not all, the simplicity and abundance of the microscopic forms and their importance in the economy of nature show that the organic world has gradually shaped itself around and has been controlled by them.

They are not only the fundamental food supply, but the prime-

val supply, which has determined the whole course of the evolution of marine life.

The pelagic plant life of the ocean has retained its primitive simplicity on account of the very favorable character of its environment, and the higher rank of the littoral vegetation and that of the land is the result of hardship.

On the land the mineral elements of plant food are slowly supplied as the rains dissolve them; limited space brings crowding and competition for this scanty supply; growth is arrested for a great part of each year by drought or cold; the diversity of the earth's surface demands diversity of structure and habit, and the great size and complicated structure of terrestrial plants are adaptations to these conditions of hardship.

The conditions of the surface of the ocean; the abundance and uniform distribution of mineral food in solution; the area which is available for plants; the volume of sunlight and the uniformity of the temperature are all favorable to the growth of plants, and as each plant is bathed on all sides by a nutritive fluid, it is advantageous for the new plant cells which are formed by cell multiplication to separate from each other as soon as possible in order to expose the whole of their surface to the water. Cell aggregation, the first step towards higher evolution, is therefore disadvantageous to the pelagic plants and as the environment is so homgeoneous at the surface of the ocean that there is little opportunity for an aggregation of cells to gain a compensating ad vantage by seizing upon a more favorable habitat, the pelagic plants have retained their primitive simplicity.

The list of pelagic micro-organisms is a long one, but a few forms are so predominant that the others have little significance at the present day in comparison, and we may regard the great primary food supply as made up of two simple protozoa, globigerinæ and the radiolarians, and about five unicellular plants.

Of these only two, the radiolarians and the diatoms, show any great diversity of species, and while the radiolarians are so diversified that the Challenger collection alone furnished more than four thousand species, this variety does not obscure the primitive simplicity of the type, and the most distinctive peculiarity of the microscopic food supply of the ocean is the very small number of the forms which go to make up the enormous mass of individuals.

LIST OF MICROSCOPICAL SOCIETIES.

By CHAS. W. SMILEY,

WASHINGTON, D. C.

[Revised to August 1, 1893. Further corrections are solicited.]

United States.

WASHINGTON, D. C.—American Society of Microscopists (migratory), W. H. Seaman, Secretary.

TROY, N. Y. —Postal Microscopical Club, Dr. S. G. Shanks, Secretary.

California.

SAN FRANCISCO, CAL.—San Francisco Microscopical Society, Geo. Otis Mitchell, Corresponding Secretary.

Colorado.

DENVER, COLO.—Denver Microscopical Club.

Connecticut.

NEW BRITAIN, CONN.—New Britain Scientific Association, M. S. Wiard, Secretary.

NEW HAVEN, CONN.—New Haven Microscopical Club.

District of Columbia.

WASHINGTON, D. C.—Washington Microscopical Society, L. M. Mooers, Secretary.

Illinois.

CHICAGO, ILL.—Illinois State Microscopical Society—A section of the Chicago Academy of Sciences. Wm. Haskins, Secretary, 81 Clark street.

DIXON, ILL.—Dixon Biological Society, Ira W. Lewis, Secretary.

PEORIA, ILL.—Peoria Scientific Association.

Iowa.

COUNCIL BLUFFS, IOWA.—Council Bluffs Microscopial Society.

Kansas.

ATCHISON, KANS.—Sphinx Society, Prof. E. B. Knerr, Secretary.

LEAVENWORTH, KANS.—Leavenworth Microscopical Society, W. D. Bidwell, Secretary.

Kentucky.

LOUISVILLE, KY.—Louisville Microscopial Club.

Maine.

AUBURN, ME.—Androscoggin Microscopial Society, C. E. Williams, M. D., Secretary.

PORTLAND, ME.—Natural History Society, C. B. Fuller, Curator.

Massachusetts.

BOSTON, MASS.—Microscopial Section of the Boston Society of Natural History.

TAUNTON, MASS.—Taunton Microscopial Society, Dr. F. A. Hubbard-Secretary.

WORCESTER, MASS.—Natural History Society.

Michigan.

YPSILANTI, MICH.—Michigan Teachers' Society of Microscopists.

Minnesota.

ST. PAUL, MINN.—Northwestern Microscopial Society.

Missouri.

ST. LOUIS, MO.—St. Louis Club of Microscopists, S. E. Barber, Secretary.

Nebraska.

LINCOLN, NEBR.—Lincoln Microscopical Club, Roscoe Pound, Secretary.

OMAHA, NEBR.—Omaha Microscopical Society, Dr. Wilkeson, Secretary.

New Jersey.

EAST ORANGE, N. J.—Essex County Microscopical Society.

NEW BRUMSWICK, N. J.—New Jersey State Microscopical Society, F. C. Vandyke, Secretary.

TRENTON, N. J.—Natural History Society.

New York.

BROOKLYN, N. Y.—Department of Microscopy, Brooklyn Institute, 200 Washington street, F. H. Hooper, Secretary.

BUFFALO, N. Y.—Microscopical Club of the Buffalo Society of Natural History, S. Hobart Dorr, Secretary.

BUFFALO, N. Y.—Naturalist's Field Club, M. A. Fleming, Secretary.

BUFFALO, N. Y.—Buffalo Microscopical Club, James W. Ward, Secretary.

CANANDAIGUA, N. Y.—Canandaigua Microscopical Society.

ELMIRA, N. Y.—UpDeGraff Microscopial Section, Academy of Sciences.

FREDONIA, N. Y. Fredonia Microscopical and Nautral Science Club, Nelson G. Richmond, M. D., Secretary.

JAMESTOWN, N. Y.—Jamestown Microscopical Society, S. W. Baker, Secretary.

FLATBUSH, N. Y.—New York Microscopical Society, 64 Madison avenue, J. L. Zabriskie, Secretary.

NEW YORK.—American Microscopical Society.

NYACK, N. Y.—Nyack Society of Microscopists, Miss Edith Stillwell, Secretary.

ROCHESTER, N. Y.—Academy of Sciences, (in the Botanical Section there are frequently microscopical exhibits), Frank C. Baker, Secretary.

TROY, N. Y.—Troy Scientific Association.

SYRACUSE, N. Y.—Microscopical Club of Central New York, W. H. Olmstead, Secretary.

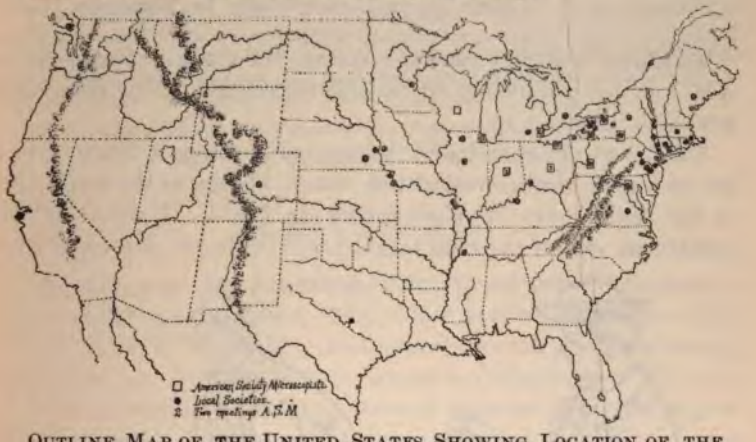
Ohio.

CLEEVLAND, OHIO.—Cleveland Microscopical Society, R. Dayton, Secretary.

CINCINNATI, OHIO.—Microscopical Section, Natural History Society.

COLUMBUS, OHIO.—Tyndall Association, C. C. Howard, M. D., Secretary.

COLUMBUS, OHIO.—Ohio State Microscopical Society.



OUTLINE MAP OF THE UNITED STATES SHOWING LOCATION OF THE MICROSCOPICAL SOCIETIES.

Pennsylvania.

PHILADELPHIA, PA.—Biological and Microscopical Section, Academy of Natural Sciences, H. Wingate, Secretary.

ERIE, PA.—Erie Microscopical Society, Rev. Geo. Goetz, Secretary.

WEST CHESTER, PA.—Microscopical Section of the Philosophical Society, F. McClurg, Secretary.

EASTON, PA.—Lehigh Valley Microscopical Society, Edgar M. Green, M. D., Secretary.

PITTSBURG, PA.—Iron City Microscopical Society, Geo. H. Clapp, Secretary.

Rhode Island.

PROVIDENCE, R. I.—Providence Franklin Society, H. S. Hathaway, Secretary.

Tennessee.

MEMPHIS, TENN.—Memphis Microscopical Society.

Texas.

AUSTIN, TEXAS.—Austin Microscopical Society, Dr. T. J. Bennett, Secretary.

Virginia.

RICHMOND, VA.—Richmond Microscopical Society.

Canada.

LONDON, ONT.—Microscopical Section, Entomological Society of Ontario, J. Alston Moffatt, Secretary.

MONTREAL, CANADA.—Montreal Microscopical Society, L. J. Skelton, Secretary.

VICTORIA, B. C.—Victoria Natural History Society, Dr. Newcombe, Pres't.

To Open A Rusty Knife.—We are indebted to *The Inventive Age*, for the following article and for the use of the cuts with which to illustrate it.

Take a piece of soft but strong cord, wind it tightly from ten to fifteen times around the closed blades of the knife and of the knife body itself as shown in Fig. 1. Hold or tie the remaining end of the cord to your middle finger. Find a grassy

Fig. 1.

Fig. 2.

spot or soft place and throw the knife down with all your might, just as you do in spinning a top and as shown in Fig. 2. The centrifugal force, caused by the unwinding of the cord and the rapid rotation of the knife will make the blades fly open like the balls on a governor of a steam engine.

If any readers wish specimens of *Vallisneria* in order to iden-[illegible] it, Dr. Reynolds will be glad to send some free of charge.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Meetings of the American Society of Microscopists.—These meetings have been held of late in close connection with the A. A. A. S. Meetings to accommodate such people as belong to the latter. The result has not been very flattering. We have heretofore explained that the interval between the two was perhaps too great and should be lessened. But now the change has been made for 1893. If it should not succeed as desired, we have an entirely new proposition to make and when the time and place are fixed for 1894, it might be tried. But first a few statistics: The society has 378 members of which 170 are physicians. Few, if any, practicing physicians go to the A. A. A. S. At the 1891 meeting of the Microscopical Society, 41 members were present, of whom 9 were residents of this city. Eighteen physicians and 23 others were present,—a mere corporals guard out of so many members, but 8 of the doctors resided here, and 10 doctors came from outside of Washington.

No profession or occupation has such a use for the microscope as the medical profession. In all local societies, the physicians constitute 40 to 60 per cent of the membership. Perhaps the American Society of Microscopists should tie to the medical conventions rather than to the A. A. A. S. It could easily sit in connection with the biggest medical convention in the United States. The Secretary could probably secure 30 or 40 papers from medical men on medical microscopy and in this way draw

hundreds of doctors into our ranks as active workers. The results would benefit not only the society but also the practitioners.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

164. *How is Hoyer's picro-carmine made, and how used?—L. W.*

Take powdered carmine 2 grains, water 1 ounce, aquæ-ammoniæ enough to dissolve the carmine while heated in a capsule, boil gently until the ammonia has evaporated, cool and filter. Make a saturated solution of picric acid in water, take 4 ounces of it and mix with the above carmine solution, filter, add a crystal of thymol, or about 1 per cent of chloral hydrate, to prevent change.

Stain sections 3 to 10 minutes. Overstaining may be extracted with 70 per cent alcohol, then use absolute alcohol, oil of cloves, balsam.

165. *Can you give the addresses of dealers in the aniline dyes used for staining?—L. W.*

Any of the dealers in microscopical supplies can furnish the aniline stains. Consult our advertising column and send for catalogues.

166. *Explain simply and clearly, how to obtain the numerical aperture of an objective.—B. E. R.*

The proper method is to use the Abbe apertometer, an instrument made for measuring N. A., and indispensable for the measurement of high angled objectives. The following method can be used to measure the angle of aperture of dry objectives. Place a microscope on a table or board, screw the objective in place and turn the tube down to the horizontal. Take a lath or similar strip of wood, 2 or 3 feet in length, drive a pin or wire nail through one end and into the table directly beneath the front lens of the objective. Arrange a small candle on the free end of the lath, so the flame will be at the same height or level as the objective, and can swing around the objective as a center,

Swing the candle to the right until the field of view, seen through the microscope, is one-half illuminated, bisected vertically. mark the position of the candle on the table, repeat the operation on the left side, marking the position there. A line drawn from the centre pin to each marked point will show the angle of aperture, approximately, (usually a little too large), which can be measured with an ordinary protractor. Microscopes having a graduated circle on the mirror-bar, may have a wax taper fastened in the place of the mirror, and the angle, obtained as above, read from the circle. This angle of aperture bears a certain relation to N. A. The rule is, *the sine of half the angle of aperture = N. A.* for dry objectives. A table of numerical aperture has been calculated, and is published in Carpenter, and other works, also in several catalogues of optical instruments. This table gives the N. A., for any given angle of aperture.

Say, a dry ¼ inch objective was measured as above and found to include an angle of 110.° Reference to the numerical aperture table will show that a dry objective, 110°=N. A. 82. Obtained by the rule, *one half* of 110,°=55.° By reference to a table of natural sines, (found in works on trigonometry), the sine of 55°=82.

167. *How may I tell the thickness of a cover-glass by using the micrometer on the fine adjustment of the microscope?—B. E. R.*

Focus successively on the dust on the upper and lower surfaces of the cover-glass. For a mounted object hardened under pressure, search for a point in the object which requires the greatest elevation of the objective for precise focus. This point is presumably in contact with the cover, and the difference between this point and the dirt on the upper surface of the cover may be measured by the movement of the divided screw-head. The values of the divisions on the screw-head must be obtained by trial over covers of known thickness.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON, CLEVELAND, OHIO.

How to Produce Pretty Crystals of Borax.—Make a saturated aqueous solution of borax. Place a drop of this solution on the center of the slide. Set the slide on a window-sill where the draft will affect the slide. Let the preparation stand until

the mass is crystalized. Beautiful crystals suitable for an inch objective will be formed.

A Method of Mounting Perithecia of Erysiphe.—Remove the perithecia with a spatula and place them in the center of the slide. Cover them with hydrate of potash and let them soak for a few minutes. Then press them with a cover-glass and partially squeeze out the asci. Wash out the potash solution with a few drops of alcohol. Then flood with eosin. Wash out the eosin with sufficient alcohol. Then mount in benzole balsam. You will have a beautiful slide showing anceptacles, asci and spores. The spores will take the deepest stain and will stand out prominently.

Flower Crystals of Sugar.—Prepare two test tubes of saturated solution of sugar; one of alcohol, the other of water. Then mix the two solutions in a third test-tube, and when throughly mixed, place a drop in the center of a slide and let it rest until it becomes a hard homogeneous mass Then set this slide, thus prepared, on the top of a student's lamp shade. In the course of a short time, the flower crystals begin to develope. Leave the slide in that position until crystals have developed over the whole mass. The crystals are now very hard and permanent and may be mounted. View it with the polariscope.

Demodex folliculorum.—This is a parasite of the cebaceous sacs and of the hair follicles of the human skin, and is found on some of the lower animals, being the cause of mange in dogs. It is also called *Acarus folliculorum*, and *Entozoon folliculorum.*

Remove a little of the cerement, place it upon a slide, put a drop of castor-oil or of olive-oil on it, tease well with needles, cover with thin cover and examine with a quarter-inch objective. The parasite, which varies in length from 1-50 to 1-100 of an inch in length can then be easily seen, often alive. This parasite is the true Acarus, and has the typical number of eight legs; its abdomen is finely striated. They can be mounted by running a ring around the cover after being prepared as above directed. When mounted in glycerine, it shrinks up and become

entirely absorbed. If it is desired to isolate the parasite from the surrounding debris, do so by patient manipulation under an inch objective, then drop a fresh drop of oil, replace the cover and fasten it with a permanent ring.

CORRESPONDENCE.

Diatoms.—H. L. Smith, LL. D., of Hobart College, our best known authority on diatomaceæ has sold to Dr. F. E. Hodges, F. R. M. S., of Indianapolis, Ind., his entire library on that subject, his collection of thousands of valuable slides, more than 4000 bottles of cleaned diatoms; also, all of the large collection of diatomaceous earths without making any reserve.

The library has few if any equals, for it contains nearly every book and paper of value ever published on diatomaceæ, also much on desmids. It might be difficult to find another so valuable collection of material in all of the other public and private collections in America.

To Prof. Smith the scientists of the world owe much, for he devoted many years of patient study, as well as a fortune in money, to investigations which gave rich returns to science, but microscopical returns to his pocket.

Advancing years and his college duties, have made it impossible for him to continue the great amount of correspondence which was required, and which was not renumerative; but which in past years gave him pleasure; and as he had the opportunity to dispose of the entire collection to advantage to an enthusiast now in the prime of life, he has done so.

Dr. Hodges now has the choicest collection of valuable slides that I have ever seen.—E. H. G.

RECENT PUBLICATIONS.

An Introduction to the study of the Diatomaceæ. By Fred'k Wm. Mills. London and Washington: 8°, 250 pp., Price $3.50.

Heretofore, if one desired to take up the study of this group of plants, he was obliged to grope his way through a mass of irrelevant matter contained in the reports of societies, to buy large and expensive volumes, and to hunt up certain old and very rare books. This, he no longer need do.

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THE MICROSCOPE.

SEPTEMBER 1893.

NUMBER 9. NEW SERIES.

OBJECTS SEEN UNDER THE MICROSCOPE.

1.—THE BRINE SHRIMP.

[PHOTO-MICROGRAPH].

The brine shrimp occurs in great numbers in the Great Salt Lake, which has usually been regarded as devoid of life. Dr. J. F. Talmage has kindly sent the accompanying illustration.

The mounting of this shrimp, *Artemia fertilis*, nicely, is by no means a simple undertaking, most of the ordinary media causing the delicate structure to become distorted, or producing such a transparency as to render the whole object invisible. The best method is to mount them in a preparation of lake water with corrosive sublimate and an alcoholic solution of carbolic acid. Into this fluid the living artemiæ are transferred directly from the lake brine; they die quickly, but in so doing spread themselves out most perfectly. By this method it is not always possible to get the mount free from foreign particles, but this is

but a slight disadvantage. Before mounting, make a very shallow cell of hot-paraffin and balsam, and after the cover-glass is in position, ring the edge with a very little of the same material, following this with repeated layers of cement, King's being preferred.

There is an interesting account of this animal in the *Microscopical Journal* for December, 1892, but the cut is recent. Dr. Talmage has forwarded the photo-micrograph from which this cut has been made by the photo-engraving process.

DE LA FACON D'OBSERVER AU MICROSCOPE,

OR, HOW TO OBSERVE WITH THE MICROSCOPE.

By M. F. LEMARDELEY,

[Translated from the French by Rene Samson.]

Does the microscope tire the eyes? Such is the first question which presents itself to persons desirous of observing the wonders of the unseen world. Let them be reassured. The use of the microscope, if our directions are followed, can but augment the sensibility of the eye by practicing it to perceive without difficulty the dullest tints and the most delicate details of structure. The conditions for working without the least fatigue are:

1.—Never observe immediately after eating.

2.—Open both eyes during study, for the fatigue that very many beginners experience is due to the effort made to keep one eye closed.

3.—Never use too bright a light.

4.—Work upon an unpolished and dark-colored table of such a height that the ocular will be on a level with the eye by bending very slightly.

HOW TO OBSERVE.—As has just been said, the place where one works ought to present an unpolished and dark surface. Any table which is a little heavy and covered with cloth or with very deep gray linen will perfectly answer the purpose. Black is not so good, for the minimum of fatigue comes at the moment when both eyes receive a nearly equal quantity of light. All the bright objects that one has at hand (oculars, objectives, etc.,) should be arranged so as not to attract the attention of the unoccupied eye.

If one observes during the day-light, he should place himself metre or 1.50 m. (3 to 5 feet) from the window and he should

utilize by preference the light of white clouds or that reflected from a wall. Blue sky does not permit any difficult observations. The sun should never be employed. In case it shines on the window, hang over it a thin white curtain which should produce an excellent light.

If artificial light is employed, use a lamp giving a white and absolutely fixed flame and one presenting the smallest surface possible. This condition is the only one which permits the most delicate observations. The light of incandescent lamps and of ordinary gas gives also some very good results but their use is less convenient and more tiring.

Illuminating the Object.—In this we have two cases to consider: (1) When the microscopist owns an instrument which is furnished with a condenser, and (2) when he has no condenser. We begin with the second case.

The microscope being placed at about 20 centimetres (8 inches) from the flame and so that the latter may be nearly on a level with the stage. Direct by means of the mirror the luminous rays on the preparation; use the plain mirror with very low power objectives, and the concave with ones of high-power. Regulate the quantity of light by means of the diaphragms. The higher the power of the objective the smaller the diaphragm ought to be and the nearer to the preparation. A too brightly lighted field is not only dangerous to the eyes, but even prevents seeing well, for the objects will be drowned in light.

If the objects that we examine present some fine details, pearls, striæ, etc., like Diatomaceæ, move away the diaphragms, or use the largest if it is a revolving diaphragm ; then incline the mirror to the right or to the left in order to obtain some oblique rays which project the image of finest details, exaggerating their importance and permitting us to perceive them better. The desired result is to see well with the least possible oblique light, for a too oblique light gives a badly illuminated field and brings about a distortion of images.

If the microscopist owns a condenser, Abbe's or any other with large aperture, he will not only have much more facility for ordinary study, but he will also be able to make some observations which would be impossible without this instrument.

For ordinary work with low-powers, one should employ the concave mirror, regulate the height of the condenser until the

image shows clean outlines, then regulate the light with the aid of the diaphragms placed under the optical system of the apparatus. In every case, when artificial light is used, one should place a lens between the lamp and the mirror, in order to obtain parallel rays.

If it is desired to resolve difficult tests with the aid of an immersion objective, raise completely the condenser, putting its surface in conjunction with that of the slide carrying the object by means of a drop of oil or glycerine or of the immersion liquid if one employs a homogeneous lens. This permits the use of very oblique rays which, without this precaution, would have suffered total reflection. It only remains now to diminish the intensity of the light by means of the diaphragms, if they are capable of being adjusted at different distances from the stage. Remove them from the axis in order to have the oblique light only on one side. If, with these arrangements, the object does not appear as is desired, take off all the diaphragms so as to expose completely the condenser, incline the mirror to the right or to the left, and when its position seems favorable, interpose between the lens and the instrument (very near the mirror) two thin metallic screens that can be brought near to each other more and more, until the moment when the extremities of the field begin to color. Then, almost always, at that moment, the least movement of the mirror is sufficient to bring out the most delicate details.

By this method, we easily resolve with the white light of a lamp, the *Navicula affinis* and even the difficult *Amphipleura.*

If one desires, the lens can be changed for a balloon full of ammoniacal sulphate of copper, which allows but one blue ray of light to pass. This is particularly favorable for the resolution.

However, in the majority of the cases. this disposition is useless for direct observation because of the important loss of light and of the facility with which one can pass through the field all the colors of the spectrum by simply bringing together the two screens above alluded to.

The study of certain colored bodies and particularly of the bacilli, is conducted with white light while leaving the condenser with its largest aperture and the mirror absolutely in the axis of the microscope. This is Koch's method. *Le Micrographe Preparateur, June,* 1893.

MODELS FOR CONSTITUTION AND BY-LAWS OF A MICROSCOPICAL SOCIETY.—II.

SAN FRANCISCO, CAL.

This Society was organized on April 12, 1872, by 15 citizens of San Francisco. On August 30, 1872, it was incorporated under the laws of Califonia.

CONSTITUTION.

ARTICLE I.—NAME AND OBJECT.

SECTION 1. This society shall be known as the SAN FRANCISCO MICROSCOPICAL SOCIETY.

SECTION 2. The object of this society is the promotion of Microscopical Science in all it branches, to be accomplished by the holding of meetings for scientific intercourse and discussion, by the reading and publication of papers relating to microscopical and kindred sciences, and by other suitable means.

ARTICLE II.—MEMBERS.

SECTION 1. The society shall consist of regular members, elected from San Francisco and its vicinity; life members constituted such by the single payment of one hundred dollars to the society; corresponding members, residing elsewhere, and honorary members, elected as such by reason of their eminence in science or attention to the micro scope.

SEC. 2. None but regular and life members shall be entitled to vote or hold office.

SEC. 3. Candidates for membership must be proposed and seconded by two members, in writing, and their names posted in the rooms of the society at least two weeks before election, and a vote of four-fifths of the members present shall be necessary to an election which election shall be void if the party so elected fail to pay the required fee and sign the constitution within thirty days after due notification thereof.

ARTICLE III.—OFFICERS.

SEC. 1. The officers of the society shall consist of a President, Vice-President, Recording Secretary, Corresponding Secretary, and Treasurer, who shall be elected annually as hereinafter pro-

vided, and shall hold office until their successors are elected and qualified. The offices of Recording Secretary and Corresponding Secretary may be held by the same member, at the discretion of the society.

SEC. 2. All elections of officers shall be by ballot, members present only voting. No member shall be represented by proxy. In case there should be no choice on the first ballot, all candidates except the two having the highest number of votes (or, in the event of a tie, the three highest) shall be dropped. The majority of all votes cast shall be necessary to a choice.

SEC. 3. The officers of the society, together with the last two living ex-Presidents residing in San Francisco or its vicinity, shall constitute a Board of Trustees, which shall have the general management of the society's business affairs, and the care and control of its property; shall appoint all subordinate officers and exercise all powers and perform all duties of a Board of Management necessary to sustain and carry on its operations. They are authorized, whenever in their opinion it is deemed advisable, to loan any instrument or materials to any member, upon receiving from such member the actual cost price of the same: such instruments or accessories to be returned to the society when required by said officers, together with proper compensation for their use.

SEC. 4. The President, or in case of his absence or inability to serve, the Vice-President shall preside at the meetings of the society and of the Board of Trustees; he shall appoint standing committees and supervise the general business of the society; he shall make a report of the condition and progress of the society in all its departments at the annual meeting, and, at his pleasure, bring to its notice any important events of interest to it. In the absence of both President and Vice-President from any meeting, a chairman *pro tem*, may be chosen, who shall preside at such meeting.

SEC. 5. The Recording Secretary shall keep a record of the Board of Trustees; receive the papers read before the society, and prepare them for publication by combining them with his reports for the press; he shall give suitable notice of time and place of meetings of the society; keep a duly classified list of the members, and attend to such other business in his department as the Board of Trustees may direct.

SEC. 6. The Corresponding Secretary shall attend to the distribution of the publications of the society to regular and other members entitled to the same; conduct correspondence with societies and individuals; notify members of their election and furnish them with diplomas.

SEC. 7. The Treasurer shall attend to all receipts and disbursements of the society, giving such bonds and furnishing such vouchers as the Trustees may require; collect all dues from the members, and keep an accurate account of the receipts and disbursements; furnish the Trustees from time to time, as they may require, with a list of members entitled to vote; and make a general report to the society at the annual meetings. The Treasurer shall pay no bill against the society unless the same has been approved by the Auditing Committee.

SEC. 8. The President shall, at the first business meeting after the annual in each year, or as soon thereafter as possible, appoint,— first, an Auditing Committee of three regular members, whose duty it shall be to examine and approve all bills against the society; second, an Exhibition Committee of three members, whose duty it shall be to make all arrangements and take charge of the public or other exhibitions of the society.

SEC. 9. The Trustees shall have the power to appoint a Curator, who shall have charge of the library, instruments, and collection of objects, and who shall enforce such rules for their management as may be prescribed by the Trustees. He shall furnish a report of additions to and condition of the library, instruments, objects, microscopic material, etc., to the society at the annual meeting.

SEC. 10. In case any office shall become vacant from any cause, the fact shall be announced to the society by the President, and an election to fill the vacancy shall be had at the next meeting after such announcement shall have been made.

ARTICLE IV.—MEETINGS.

SECTION 1. The annual meeting, for the election of officers and other business, shall be held on the first Wednesday in February. Stated meetings, for microscopical research, shall be held on the first and third Wednesdays of each month. Special meetings may be called at any time by the President or by any two officers. Notice of annual and special meetings shall be sent to each regular and life member, or by advertising, if so directed.

SEC. 2. Meetings of the Board of Trustees may be held at any time and place, at the call of the President. The President shall also call a meeting of the Board of Trustees whenever requested to do so by any two members thereof. Three trustees shall constitute a quorum for the transaction of business.

SEC. 3. Five members shall constitute a quorum for the transaction of business at any stated or special meeting, and seven members shall constitute a quorum for the transaction of business at the annual meeting.

ARTICLE V.—FEES AND DUES.

SECTION 1. Regular members shall pay an initiation fee of twenty dollars, and one dollar per month dues. Regular members desirous of becoming life members can do so upon the payment of seventy-five dollars

SEC. 2. Any regular member in arrears for dues more than three months, except in case of absence from the state, shall be notified in writing by the Treasurer, and if his dues remain unpaid for one month thereafter, his name may be dropped from the list of members.

SEC. 3. All money received for life membership shall constitute a special fund, to be invested by the Board of Trustees, and only the income derived therefrom shall be used for current expenses. This fund shall not be used for any purpose without a vote of two-thirds of the members present at a stated or special meeting, and notice of such intention having been given in open meeting at least two weeks previous.

ARTICLE VI.—PUBLICATIONS.

SECTION 1. The permanent publications of the society shall be directed by a Committee on Publications, under the general supervision of the Trustees.

SEC. 2. Each regular, life, and honorary member shall receive, free of cost, one copy of all publications issued by the society during membership.

ARTICLE VII.—AMENDMENTS.

SECTION 1. Amendments to this constitution may be made at any annual meeting, without notice and at any stated or special meeting called for the purpose, upon notice of two weeks, stating the substance of the proposed amendments.

2. All or any part of this Constitution may be sus-

pended at any meeting, by a vote of two-thirds of the members present, notice of such intention having been given at least two weeks in advance.

ORDER OF BUSINESS.

1.—Reading of Minutes; 2.—Applications for Membership; 3.—Election New Members; 4.—Reports of Committee; 5.—Additions to the Library; 6.—Donations to the Cabinet; 7.—Unfinished Business; 8.—New Business; 9.—Written and Verbal Communications.

HAIR-PIN CLIPS.

By O. H. HUBBARD, M. D.,
WALPOLE, MASS.

Among the many handy home-made instruments which I have devised since I began microscopic work, some made from ladies hair pins have proved very useful and satisfactory. Needing a large number of spring clips, I purchased five cents worth of medium-sized hair pins and with a pair of pliers bent one leg of the pin as in fig. 1, the other leg was then shaped as in fig. 2.

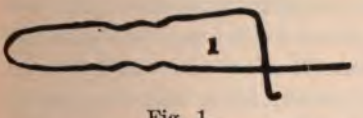

Fig. 1.

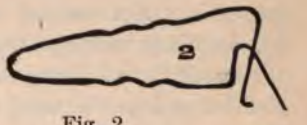

Fig. 2.

In using, the edge of the slide is placed on the side of the **V** shaped lower limb. The upper one is raised and the slip is then slid under it far enough to allow the point of the upper limb to rest on the center of the cover glass. The pressure can be varied by bending the angle of the pin.

PRACTICAL HINTS TO WORKERS.

By F. L. JAMES, M. D.,
ST. LOUIS, MO.

Do not throw away alcohol and benzol that you have used for washing or other purposes, and which is not sufficiently pure to return to the container. Have a pint bottle with a glass stopper at hand, and pour these little residues into it. When it is, say half full, scrape up some castile soap and put into the bot-

tle. Add an ounce of strong ammonia water, or half that quantity of liquor potassæ, shake up, and you will have a liquid soap that will remove from the hands or clothing any of the gums, cements, etc., used in mounting. Even marine glue yields to it like magic.

Sharpening the little knives used in minute dissections is one of the most difficult things to even old workers, and yet one of the simplest imaginable after you get the hang of it. I use for this purpose three hones—a quick-cutting, somewhat coarse, barber's hone (those backed with slate are best), a fine hone of the same sort, and lastly, the finest Ouachita (Hot Spring) hone. Soap and water, or lather, is used to keep the hone wet. If the knife is quite dull, commence with the coarse hone. Lay the blade perfectly flat on the stone and move it, edge foremost, straight over the stone, being careful to carry the hand with it in such manner that the blade shall remain flatly in contact with the hone the entire distance. This is the first secret of success, and you will find it somewhat difficult to accomplish at first; but with a little care and attention the movement soon becomes automatic. Do not bear or press on the blade. This is the second essential point. Let the blade slip lightly over the stone, in exact contact, but exert no undue pressure. If you do, the blade bends at some point and wears away there, instead of smoothly all along the surface. Having removed sufficient of the metal and secured a roughly-sharp edge, take the second or smooth hone, and proceed in the same manner, keeping plenty of lather on the stone. One way of judging whether your blade is laying quite flatly on the surface is to note whether it moves the bubbles of lather to one side or the other, or whether it slips under them, leaving them in place. The latter is the way it should do. A few passes on this stone will be sufficient. The finishing on the Arkansas hone is performed in the same manner, only greater care should be exerted to prevent any pressure. When the knife comes from this hone it should be bright and polished almost as smoothly as though it had been against a polishing buffer. It is now ready for use. A strap for such knives, indeed, for any knife, is an abomination. It simply rounds and dulls an otherwise perfect, wedge-like edge. If a point has been broken off restore it on the coarse hone first, before you commence to sharpen. To this end, pass the blade, if

very delicate, through a cork that has been rudely squared so as to afford a finger-hold and to serve as a guide for the proper position in which to hold the blade. Holding the latter, edge downward, on the stone, move it lightly backward and forward with a scraping motion until you wear off sufficient metal. Examine, from time to time, to see whether you are getting the proper shape to the point. Repeat the operation with the back of the knife downward. After you have sharpened the blade on the rough hone you can sharpen the curved edge of the point. Beginners had better replace the cork for this operation, leaving just sufficient of the blade exposed to rest firmly and smoothly on the hones. If there are gaps along the edge remove these, too, before beginning to sharpen. This is done by holding the edge perpendicularly on the stone and scraping backward and forward until the entire edge is worn back to the depth of the gap. This keeps the edge true and straight.

It sometimes happens that one wishes to use a bottle in a great hurry, and a clean, dry one is not at hand. If you wash out a bottle in the ordinary way, it takes a good while to dry completely. If you want to put, say a solution of dammar, or benzol, or zinc cement into it, it must not have a single drop of moisture in it. I will tell you how you can use it in a half minute after rinsing. Shake out all the water that you can get rid of by swinging the bottle, mouth downward, to and fro. Then go to your alcohol jar, fill your bottle quite full of alcohol, and pour it back into the jar. The residual drop or two of water will not materially lower the strength of your stock. Shake out the few residual drops of alcohol and repeat the same operation with absolute alcohol, returning the latter to your stock. Then if you are very particular, you may proceed in the same way, using benzol as a rinser. The bottle is then clean, ready to be filled. The same process may be followed with a sable pencil, a costly brush or article of that sort that has been used in an aqueous medium, and you wish to transfer it at once to an enamel or cement bottle. Wash it in water to get rid of the medium, rinse first in water, next in alcohol, then in absolute alcohol, and finally in benzol. If it has been in some gummy or oily material and you wish to use it in an aqueous or other medium, wash it with the liquid soap described above, rinse with clear water, and it is ready for use again.—*National Druggist.*

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Prices of Drugs.—The average price of drugs is 3½ times as much in the United States as in Denmark. What costs 75 cents in New York can be bought in Copenhagen for 20 cents. In Norway, Sweden, Belgium, Germany, Austria, Holland, Hungary, Switzerland, and Portugal, the prices of drugs average less then half what they average in the United States.

Pork Packing.—One firm in Chicago, during 1892, packed the meat from 1,189,498 cattle; 1,134,692 hogs; and 1,013,527 sheep. The sales amounted to $90,000,000. We have written to the firm to ask what microscopical methods they employ for detection of trichinæ and other diseases affecting meat and hope to be able to publish an interesting account.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

168. *Explain how to centre and use an Abbe condenser so as to get the best illumination for ordinary objects and bacteriology?—B. E. R.*

A condenser is centered by means of a cap, with a small central perforation, slipped over the top lens. Use the plane mir-

ror for light, and an inch objective focussed on the perforated cap. Move the condenser about until the perforation is exactly in the centre of the field, then secure it. Practice with familiar objects, like blood corpuscles, diatoms, etc , until the effect of various openings and positions is known. Central light is the rule for histological work. When using high-angled objectives, as in bacteriology, make immersion contact with glycerine or hom. imm. fluid between the top lens of the condenser and the lower side of the mount. With high-angled objectives, there is no such breaking-down of the images under a flood of light as may be seen ordinarily with the low-angled objectives. With the latter, delicate details require a dimmed light producing a dim, uncertain image. With the former, a much brighter light can be employed and sharp, crisp details enjoyed.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON, CLEVELAND, OHIO.

Mounting Cyclops.—It is desirable to mount *Cyclops quadricornis* so that the egg sacs will be preserved. With patience, time, and perseverance, it can be done.

Begin by first preparing the slides with white-zinc rings. Lay them away until the rings are dry and hard. When the slides are thoroughly seasoned, place a Cyclops within the ring and a cover glass on the ring, thus enclosing the Cyclops with a ring full of water under the cover. Make a mounting fluid by mixing one-half lime water and one-half glycerine. Run the lime mixture under the cover at one side and soak out the original water at the other side with a piece of blotting paper. The reason for using lime water with the glycerine is, that the Cyclops is composed largely of carbonate of lime which pure glycerine will dissolve and destroy. Make a white zinc ring so as to fasten the cover temporarily. Set it away to dry and harden and in a day or two add another ring, repeating successive rings until a properly finished ring is made. It may take a week to finish a slide properly, but prepared in this way, one cannot fail to succeed. Undiluted glycerine will cause the Cyclops to disappear. This method, was invented by Mr. Montague Rogers, of Cleveland, and it brings this Entomostracan into a natural position with horns and egg bags extended.

From March until September, the Cyclops appear in great numbers in Lake Erie, and are plainly visible to the unassisted eye, so that one can pick them out with a spoon, or with a dipping tube. From a glass full of Lake Erie filterings, which can be replenished weekly, one can always secure specimens.

The Pollinia of Milkweed.—These pollen masses of the milk-weed or silk-weed make beautiful slides. Under illumination from the mirror, they resemble plates of gold. Remove the pollinia from the stamens with a needle and place them on a slide. A few minutes practice will make one expert. Mount at once with benzole balsam.

Spiral Cells of the Castor Oil Plant.—The spiral cells of this plant can be easily obtained and mounted. Take one of the dry stems, after the plant has withered in the fall. The long perpendicular fibres which may be readily stripped out from the inner side are the spiral fibres. Strip out a sufficient quantity to make a slide and trim them; then stain with carmine, or other suitable stain, and clear with alcohol. Let them dry on the slide and mount in balsam. The fibres will curl up and appear as a lot of beautiful ringlets.

White Zinc Mounting.—Very perfect mounts may be made with white zinc. Procure a tube of white zinc from a dealer in painters' supplies, and from the same source obtain a bottle of prepared linseed oil. Mix a sufficient quantity of the zinc and oil to make the number of slides you desire, and prepare it as if for painting. When well mixed, and of a proper consistency to flow readily, run rings on the slides with a fine brush. Then, with a knife point perfect the rings on the turn table. Set the slides away to dry; keep them flat, and free from dust. A dry mount may be made with one of these cells by placing the cover on the hardened ring and cementing it by heating a plain slide and placing it over the ring until a narrow margin runs under the cover. Then run any suitable outside ring. A ring prepared as above and thoroughly dried and hardened will hold glycerine many years. To use with glycerine, fill the cell, put the cover on, and then run a slight ring of white zinc. Set it away to dry. The next day run another ring. Dry it 24 hours, and so on, until the outer ring is good.

Finish these outer rings at the time of putting them on, by running them upon the turn table with the point of a penknife.

SCIENCE-GOSSIP.

Method of Mounting Calcified Microscopic Specimens.—Mr. J. Mansbridge finds the one great disadvantage in the use of fluid balsam as a mounting medium for calcified specimens, where it is advisable to retain the air in the structure for purposes of clear definition, is the liability to run into any spaces, such as lacunæ or tubuli that may exist in the tissue. To overcome this difficulty, he uses dessiccated balsam in the following way:—Take a clean slide, place it upon a hot table with a small lump of balsam upon it, and cover with a hot cover glass, which must be pressed down in such a way as to expel all air from beneath it. Remove the slide to a cool surface and continue to keep pressure upon the cover glass for a few minutes, when the balsam will be found to be quite hard and the specimen ready to be labelled and to be put away. He finds the advantages: (1) There is no chance of the mounting medium running in and spoiling the section, as it becomes perfectly hard a few minutes after removal from the hot table (2) The specimen is finished at the time and is ready for the cabinet. There is no need to use a clip, no fear of the cover-glass shifting if the slide is placed upon its side. (3) It is very convenient for teaching purposes, as the ordinary stiff balsam soon gets into a most deplorable condition.—*Trans. Odont. Society.*

To Make Gold Crystals.—Get some neutral terchloride of gold and make a solution of about ten per cent in strength; put into it a piece of zinc, and you will see an immediate outgrowth of black metal, then the gold will push forward in lichen-like masses, green, lilac, or yellow, followed, perhaps, by yellow or black fringes, and ending in delicate aborescent forms. A yellow branch will often run rapidly around the edge of the drop. The gold salt is also apt to crystallize on the glass plate in long needles and the metallic fronds follow up these long crystals which disappear before them as though devoured by their advancing points.—*Boston Journal of Chemistry.*

To Take Aniline Stain Out of Cloth.—Dissolve one part of Sodium Nitrate in two parts of dilute sulphuric acid and 75 parts of distilled water. Let it stand over night. Apply gently and rinse carefully.

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THE MICROSCOPE.

OCTOBER, 1893.

NUMBER 10. NEW SERIES.

OBJECTS SEEN UNDER THE MICROSCOPE.

2.—HEAD OF A TAPE WORM.

[PHOTO-MICROGRAPH.]

The tape worm is one of the Entozoa and is called *Tænia crassicolis*. It is to be found in the intestines of many kinds of animals, the present illustration having been derived from one

taken by Dr. Talmage from the liver of a rat. We call this "the head" of the animal because it is at the end where a head ought to be and because it is the organ nearest approaching a head. But one will search in vain for eyes, nose, ears or mouth. The prominent feature consists of the 30 to 40 projections which, in the picture, look like horns; but which, like tentacles, simply enable the animal to attach itself to a place where it can obtain nutriment. We say nutriment, and not food, because having no stomach, it cannot digest food. It takes in through the pores of its body, the nutriment its host has prepared for itself.

SIXTEENTH ANNUAL MEETING OF THE AMERICAN MICROSCOPICAL SOCIETY.

HELD AT MADISON, WIS., AUG. 14 AND I5, 1893.

Monday, August 14, 1893.

The American Microscopical Society held the first session of its annual meeting in science hall, at University of Wisconsin, commencing at 10 o'clock. The attendance was small, owing partly to the attractions of the World's fair, partly to the fact that most of the members reside east of the Alleghanies. The following new members were elected: Miss Edith J. Claypole, Akron, O.; Henry C. Bennett, New York City; James C. Gregory, Nyack on Hudson, N. Y.; Herman Schrenck, New York City; Agnes Winslow Foster, Brewster, Mass.; Dr. Wm. H. Knap, Chicago, Ill.; John H. Madden, Chicago, Ill.; B. N. Werum, Toledo, O.; John D. Locke, Haverhill, N. H.

The society voted to publish 500 copies of its proceedings next year. The committee on universal screw reported progress and was continued. It was also voted to add abstracts of American microscopical work to the proceedings. The local committee gave an invitation to an excursion on Lake Mendota Tuesday evening, which was accepted. It was decided not to give a soiree this year. In the afternoon the society listened to an elaborate description by Prof. W. S. Miller, of Wisconsin University, of the methods of reconstruction of the lung from thin serial sections, many hundreds of which are made about two-hundreths of a millimeter or one twelve-thousandth of an inch in thickness, and sheets of wax one-twelfth of an inch thick or 100 times as thick, which are cut out like the sections, only 100 times as large, and are piled on one another till a part of a lung is modeled on a scale 100 times the size of the actual organ. Thus the real construction is made much more familiar to the mind of the student. Other organs may be made in the same way.

In the evening at 8 o'clock, the members of the association met in the assembly chamber of the capitol with a goodly number of Madisonians. Short addresses of welcome were made by Mayor Corscot on behalf of the city, General Lucius Fairchild, chairman of the local committee and President C. K. Adams on behalf of the university. Hon. J. D. Cox, introduced them.

After the addresses of welcome, Prof. Jacob D. Cox, of Cincinnati, Ohio, President of the American Microscopical Society, read a paper entitled: Why the Technique of the Microscope and its Accessories Should Systematically be Taught in Our Universities. Mr. Cox is dean of the law school of Cincinnati college. He was governor of Ohio in 1866 and 1887 and was Secretary of the Interior in President Grant's cabinet. His paper, while necessarily technical to a degree was from time to time embellished with illustrations of microscopical achievements which made it highly acceptable to a popular audience. He urged the desirability of a somewhat extensive course of technical instruction and training in regard to the microscope, backed by so ample a collection of stands, of objectives and of accessory apparatus as shall give the university student the opportunity to judge for himself under the guidance of a competent instructor. of the practical value for general or for special use of the various forms of instruments of different types. The proper procedure in selecting instruments, etc., was dwelt upon The apparatus necessary for the thorough prosecution of microscopic work is so expensive that there is scarcely an individual who can make a collection of kinds which is anywhere near complete; so for the best results to be obtained some large organization like our great universities must take up and prosecute the work. He pointed out wherein microscopic research is becoming a real necessity in the various pursuits of daily life and wherein the facilities for research could be vastly improved. There is an undeniable field for instruction in the technique of the instrument and its accessories, said Mr. Cox. There is room for further improvement in the microscope itself and everything connected with it. There is need for a place where the worker may find everything of value which has been invented or devised, and an opportunity to learn or to test its value by actual comparison or in use. If our universities will furnish the plant and the instructors, they will do, in a better and more thorough way, what the microscopical societies of Europe and America have been trying to do; or perhaps will make only more satisfactorily clear the advantage to science of such societies, by giving to every student the ground work which will ensure not only his progress but his lasting interest in these technical studies. At some length the speaker then analyzed the lines of

work which open to the microscopical student, and of the questions in technique or in construction which may fairly be said to be still undecided. Then followed a very interesting story of the use of the microscope in the hands of all users from the novice to the expert. Mr. Cox pointed out a hindrance to the rapid advancement of microscopical science which applies as well to the advancement of other movements. It is the tendency to follow leaders too closely. In microscopy, Mr. Cox said, the remedy for this is the opportunity for proving all things by the systematic study of technique under favorable conditions. A fresh, bright mind in a laboratory, when encouraged to use his own ingenuity, is constantly surprising us by the fertility of his invention and the rapid progress he will make. Give him the same opportunity in comparing the merits of his instruments and apparatus. Supply him with good examples of all the different styles and kinds. Free him from bondage to any tradition and stimulate him to use his own powers here as you do in pure science, and I cannot doubt he will surprise us, not only with the justice of his choice, but with still greater improvement in all that makes investigation with the microscope sure and easy. In closing Mr. Cox emphasized the point that the university is the proper place to advance this work and called upon the society of which he is president to do all it can in seeing that the desired end is accomplished.

Tuesday, August 15, 1893.

The American Microscopical Society reassembled at a few minutes past 10 o'clock Tuesday morning and proceeded to elect the new members.

The following named persons were elected to membership: Michael V. Ball, Philadelphia, Pa.; Enoch Mather, Paterson, N. J.; Thomas Craig, Brooklyn, N. Y.; May Fischer, Jena, Germany; James C. Ternan, Rochester, N. Y.; John E. Davies, Madison, Wis.

A committee was appointed to nominate officers for the ensuing year as follows: Wm. A. Rogers, Wm. H. Walmsley, E. Bausch, R. H. Ward, M. D. Ewell. The society decided hereafter that it would apply the word "exhibition" to its evening entertainments, in place of the word "soiree," and that the exhibition would be dispensed with this year.

The committee on prizes for microscopical investigation appointed last year reported the awards as follows. One prize of $50 to Miss Edith J. Claypole, of Akron, Ohio, for her examination of the blood of Necturus and Cryptobranchus; one prize of $50 to Herman Shrenck, of Brooklyn, N. Y., for his investigation of the parasitical relations of epiphegus, or beech drops, a plant without chlorophyl, growing on the roots of beech trees (both of these essays were theses for a degree from Cornell University and were copiously illustrated by numerous beautiful drawings); one prize of $20 for six microscopic slides, illustrating the structure of the human spinal marrow, by Wm. C. Krauss of Buffalo, N. Y.

Prof. W. W. Rowlee, of Ithaca, N. Y., read a paper on the aerating roots of *Mikania scandeus*, a climbing plant belonging to the Composite on the banks of streams, and throwing fine roots upward from its main roots, the sole object of which appears to be to convey air to the interior of the root system.

In the afternoon the society listened to a demonstration of the use of apparatus for photomicrography by Dr. A. C. Mercer, of Syracuse, N. Y., and continued by Prof. S. H. Gage, of Ithaca, N. Y., W. H. Walmsley, of Philadelphia, and others.

LIST OF PAPERS ENTERED FOR PUBLICATION.

The following papers were laid before the society on Monday and Tuesday August 14 and 15.

A spectroscopic study of colored inks, by M. D. Ewell.

A metric study of 2000 check signatures, by M. D. Ewell.

A steel bar plated with Iridium for micrometric purposes, by M. D. Ewell.

The simplification of laboratory methods, by Wm. C. Krauss.

The minute structure of certain aerotropic roots, by W. W. Rowlee.

Progress in investigation of diatom structure. Some new photomicrograps by T. H. Smith of London, by Jacob D. Cox.

Some points in the history of a new Distoma, by Henry B. Ward.

The arrangement and structure of the muscles of the Lamprey (Petromyzon), by S. H. Gage.

Sarcina ventriculi in medico-legal investigations of blood stains, by W. N. Sherman, M. D.

A new clearer for collodion, by Pierre A. Fish.

On the blood of Cryptobranchus and Necturus, by Edith J. Claypole.

On the structure of the teeth and bones of Paleozoic fishes, by E. J. Claypole.

The action of leucocytes towards foreign matter, by Miss Edith J. Claypole.

The effect of acid urine and solutions of chromic acid on red blood corpuscles, by M. L. Holbrook, M. D.

On sectioning fern prothallia, and other delicate tissues, by Mason B. Thomas.

Parasitism of the Broom rape on beech roots. Epiphegus on Fagus, by Herman Shrenck.

A contribution to the study of the Myelin degeneration of pulmonary alveolar epithelium, by Veranus A. Moore, M. D.

A plea for the study of reagents in micro-work, by V. A. Latham.

OFFICERS ELECTED FOR 1893-'94.

For President, Dr. Lester Curtis, Chicago, Ill.
Vice-Presidents, Prof. W. W. Rowlee, Ithaca, N. Y.
Prof. W. S. Miller, Madison, Wis.
Secretary, Wm. H. Seaman, Washington, D. C.
Treasurer, C. C. Mellor, Pittsburg, Pa.
Executive Committee, Dr. Lyman Deck, Salamanca, N. Y.
Dr. V. A. Moore, Washington, D. C.
Prof T. D. Biscoe, Marietta, Ohio.

COLLECTING DIATOMS

By F. W. MILLS,

HUDDERSFIELD, ENGLAND.

[Chapter VII, of his "Introduction to the Study of the Diatomaceæ."]

The diatomist has not far to turn in quest of objects for collection and preservation. As has already been observed in the first chapter, this class of microscopic life is almost universal. It may be met with in fresh, salt, or brackish water in a living state, and large beds of frustules in a fossil state exist; as for instance at Dolgelly. Our mountain streams, lakes, ponds, and ditches contain vast numbers of specimens, which may be collected all the year round. Oyster beds abound with them, and the stomach of almost every fish will yield a good supply.

"Their living masses," says the Rev. W. Smith, "present themselves as coloured fringes attached to larger plants, or forming a covering to stones or rocks in cushion-like tufts (or spread over the surface as delicate velvet), or depositing themselves as a filmy stratum on mud, or intermixed with the scum of living or decayed vegetation floating on the surface of the water. Their color is usually a yellowish-brown of a greater or less intensity, varying from a light chestnut in individual specimens to a shade almost approaching black in the aggregated masses. Their presence may often be detected without the aid of a microscope, by the absence in many species, of the fibrous tenacity which distinguishes other plants. When removed from their natural position they become distributed through the water, and are held in suspension by it, only subsiding after some little time has elapsed."

The Diatomaceæ have been divided into two classes, by Herr Johann Nave, viz.:—the free species, or those which have an independent existence; and the stipate, or such as are attached to other objects, generally Algæ, by means of a stalk. There is however a third division comprising the frondose species, or those in which numerous individual frustules are enclosed, held together by a gelatinous mass, and in appearance not unlike sea-weed.

The free growing species are found entangled with algæ and mosses, or below the surface of the water, wherever the soil, stone, or a fallen leaf is stained with a yellowish brown hue. In rapid streams and mountain torrents they become scattered and numbers of them remain suspended in the foam and may be easily gathered. Also when the sun is shining they liberate oxygen and rise to the surface with the gas. Whenever these minute bubbles are seen to be coloured brown, it may be taken as a sure sign that Diatoms are present.

Certain stipate Diatoms are exactly similar to others of the free kind so far as their frustules are concerned, and their stipate existence forms a convenient basis for distinguishing the families.

As examples of the very close approximation in the form of the frustule may be mentioned, the *Cymbella* and *Cocconema*; *Sphenella*, and *Gomphonema*, which are respectively separated solely on account of this difference.

Stipate Diatoms may be found adhering to the larger algæ and similar water plants, tinted with a reddish brown.

When collecting, a number of phials with wide mouths, furnished with corks, should be carried. The mouth of the bottle being closed with the thumb it is brought close over the coveted colony in the water, and on removing the thumb, the water and Diatoms will rush in. A spoon is frequently used in removing layers of Diatoms from sand at the bottom of pools and rivers. If the masses of Diatoms are entangled amongst algæ, they may be detached and collected by means of muslin nets affixed to a rod. Telescopic rods, like Japanese fishing-rods can be procured for carrying the net or a bottle, and are often useful in obtaining specimens which would be otherwise beyond reach.

Diatomaceæ are, as has already been stated, found in fossil form in great numbers, seldom however containing a great variety of species. The mass may sometimes be disintegrated by placing lumps of it in a test-tube, covering them with *Liquor potassæ*, boiling for a short time until the whole breaks up into a sort of mud, which should instantly be poured into a quantity of distilled water and well washed.

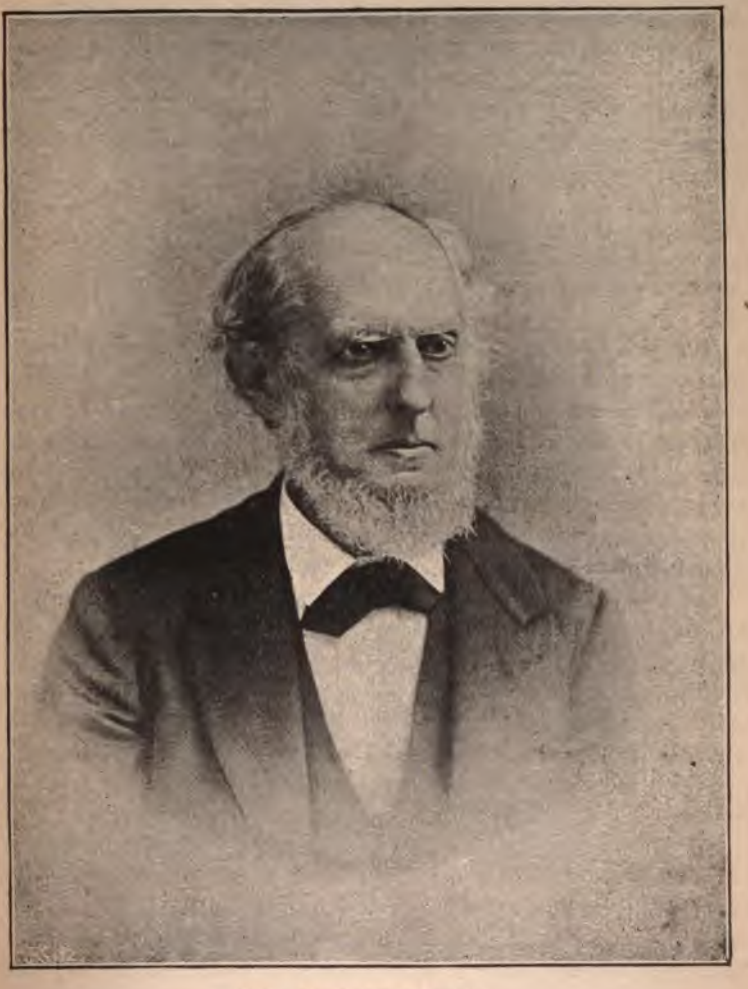
THE INVENTOR OF THE FIRST PAPER BAG MACHINE.

By R. G. DUBOIS, WASHINGTON, D. C.

[FROM THE INVENTIVE AGE.]

The man who produces a useful invention does more for humanity than the discoverer of a planet. The Rev. Francis Wolle was the first man in the world to invent and build a machine for making paper bags. Before his day, paper bags were made by hand and were too costly for ordinary use, being held in reserve for the more expensive class of goods, but after his invention they became more commonly used than ordinary sheets of paper. If we should aggregate the time saved to each waiting customer in a store, by the use of bags instead of the old sheet folding process, it would amount to enough to build forty railroads around the globe. Dr. Wolle was born in 1817, and when about sixteen years of age was employed in his father's store at Bethlehem, Pa. While engaged there the idea of making paper bags by machinery first entered his thoughts, but

not until 1850 was he able to put the ideas of former years into practical shape. After 14 years constant work in the school room, his health failed and he sought recreation in the work of



REV. FRANCIS WOLLE.

constructing a paper bag machine. In 1852 he received his first patent, and he built a few machines in 1855. He then went to Europe where more patents were procured. His brother was with him constantly giving financial aid. After seven years

devoted to putting the machine on the market, and spending about fifty thousand dollars defending his claims, he sold all his interests in the inventions, gaining financially very little. After disposing of his patents he returned to educational work, and became principal of the Young Ladies Seminary at Bethlehem, Pa. Resigning the position in 1881, he gave his entire time to the study of botany, after which he became the author of several botanical works. His busy and useful life ended February 10, 1893.

THE TARIFF ON SCIENTIFIC BOOKS.

By J. EDGAR BULL,

NEW YORK.

In every controversy both sides are partly right and both are partly wrong. This is the fundamental character of controversies and a partisan who fails to see any justification for the convictions of his adversaries may safely write himself down as unworthy of respect. A conclusion, if worth anything, is a balance struck between opposing reasons; and as to the wisdom of imposing a tariff on scientific books, I, for one, have not yet struck the balance. But I have some suggestions to make.

Scientists as a class are public benefactors. They give far more than they receive. Of course, to those who can see in the tariff only a tax on scientists, the question is simple enough. To those who see in it more, the question is rather complex. Any plan that would increase scientific investigation in this country should be adopted. But supposing that—as we are told—owing to cheaper labor, cheaper material and lower rates of interest, books published in London can be sold here for less than those published in New York; might not our scientists who wish to publish something, be deprived of some part of their small incomes; if they are without protection might we not miss the stimulus of individual and national effort; might not American science suffer? I do not say it would—I merely ask the question. Scientists must live and must earn dollars. If their opportunity to publish be dimished, will American science be the gainer or loser? The effect of a national literature cannot be estimated in dollars and cents, but it is not easy to overestimate it.

Some of these remarks do not, perhaps, apply to the publication of purely original investigations; but those are in pages, not in volumes; and are addressed, except in periodicals, to a very limited audience. The dilitante are to the scientific in numbers as hundreds to one. I, a useless dabbler myself, speak, I think, for the vast majority when I say that if some part of the extra price we have paid for American scientific literature has found its way into the pocket of the needy author, or has made publication possible for what would otherwise have remained in manuscript, we are satisfied. It is little enough to ask of us. Science cannot flourish in any country without artificial encouragements. If it were not for the princely munificence of private individuals who have endowed our educational institu tion and kindred enterprises we would not have any purely scientific men worth speaking of, because theirs is not a money-making business. The greatest scientists are not the greatest book-worms. Those who read most discover least. It is desirable to encourage not absorption, but investigation. I doubt if the cause of science ever suffered because an original investigator did not have money to buy more books. Those who would derive pleasure or profit from the discoveries of others are the great book-buyers and why not let them pay for them? At the highest they do not give anything like what the information costs, or is worth. My preference is for increasing the author's royalty instead of cutting down his market.

Before the passage of the new copyright law we were at liberty to republish English works without paying a copper for the brains that were in them. Of course, the effect of the law is to increase the price of certain books and yet I suspect that even the editor of this periodical favored its enactment. If he did, he must admit that cheapness is not after all, the only element to be considered.

To Mount Volvox.—Prepare a medium as follows: Copper acetate 8 grains, glycerine 4 oz., camphor water 2 oz., glacial acetic acid 10 drops, water 2 oz. Mix these ingredients and filter the product, mount as usual.

To Mount Fresh-Water Algæ.—Take acetate of potash 1 part, water 2 parts, mix. If crystals form add more water. This medium will not destroy the chlorophyl.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Diatomaceæ and the Paper Bag.—We quote elsewhere a short article from *The Inventive Age* in which has been published a kind notice of the Rev. Francis Wolle's career as an inventor In the *Microscopical Journal* has already appeared a notice of Mr. Wolle's work upon the Diatomaceæ and upon the Algæ. A man who at the same time earned a reputation as inventor and as an authority upon plant life deserves more then a passing notice. It is the misfortune of most scientists to be so unpractical in their thoughts and habits as to cause comment and often ridicule. It is the misfortune of most inventors to be ignorant of Natural History and Physics. The Reverend gentleman alluded to was not only a scientists and an inventor but a clergyman and a teacher. As microscopists we feel deeply indebted to him for his published works relating to those obscure forms of vegetable life which excite our interest and curiosity, but we can appreciate also the work done by him in other and possibly more practical fields of labor.

The American Society Meeting.—Not being able to go to Madison, Wis., to attend the meeting this year, we were unprovided with reports until Professor Seaman came to our rescue and furnished some items. We are also indebted to the *Madison Democrat* for copy. We shall be glad to have authors who pre-

l papers furnish us with abstracts for publication.

Carborundum.—This new compound is made from carbon, sand and salt, but it is composed of silicon 69 per cent, carbon 30, impurities 1 per cent. Under the microscope it exhibits crystals of a blue color, but with some of a yellow-green color, some black, and some white. Mr. Hagen has kindly favored us with some specimens of this new crystal.

To a limited number of subscribers we can mail enough to make a few mounts, and to all our contributors who so desire we shall take great pleasure in sending samples.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

169.—*Describe fully how to stain bacilli to show spores, flagellae and capsules.—Enquirer.*

Lœeffler's method is best for flagellæ. Take 2¾ drams of 20 per cent solution of tannin in water, add 1½ drams of a cold saturated solution of sulphate of iron and 16 drops a saturated solution of fuchsin, or of methyl blue, in water and mix well. Just before using, add 16 minims of a 1 per cent solution of sodium hydrate. This is the mordant.

The staining fluid is a saturated solution of fuchsin in aniline water. Add about 20 drops of a 1 per cent solution of sodium hydrate to 4 oz. of the stain.

The cover glass should be prepared from a pure culture because albuminous material will be stained also and obscure the delicate flagellæ. Pass the film lightly through a flame, flood with the mordant, heat until steam arises, and wash thoroughly. Flood with the stain and steam as before, let the stain act for one minute, wash thoroughly, dry, and mount in xylol balsam.

The above aniline-water fuchsin will stain capsules. The prepared cover must be carefully flamed as above, because the capsules are very easily destroyed. Prepared covers for spores should be rather strongly flamed. Spores are very resistant and are best seen when the bodies of the bacilli are partly destroyed. Too much flaming will destroy the bacilli so that after

staining the spores will appear isolated and their relation to the bacilli not easily recognized.

See the A. M. M. J. Vol. XIII, Page 3, for an excellent article by Dr V. A. Moore.

170.—*How can I stain sputum for the Pneumococcus, and material from the brain for bacteria in meningitis?—L.*

Make two fluids: an aniline-water-fuchsin as above, and saturated solution of methyl-blue in water. Prepare cover glasses by flaming. Stain in the fuchsin about one minute, then immerse in the methyl-blue about three minutes. Wash in water, dry and mount in xylol balsam.

171.—*Give the best method for staining anthrax bacilli in tissues, diphtheria and typhoid bacteria in tissues and on covers.—L.*

Take Methyl blue, 2 parts; alcohol, 15 parts; water 85 parts; and mix well. The sections should remain in this stain for 24 hours, then be very carefully decolored in weak acetic acid.

Too much bleaching will bleach the bacilli also. A certain pale blue tint will indicate that the tissue is well bleached and the bacilli practically untouched. Wash quickly in water, dehydrate in absolute alcohol, clear in oil of origanum and mount in xylol balsam.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON, CLEVELAND, OHIO.

Cuticle of Equisitum.—The cuticle of the Scouring Rush (*equisitum*) is a fine polarizing object. To mount, cut the stems into suitable sizes. Place the pieces in a test-tube half full of water, add a few drops of nitric acid and boil for a few minutes over a spirit lamp. The cuticle which is pure silex, separates from the vegetable portion and rises to the surface. Next, wash thorourghly so as to remove all traces of the acid. Then place the pieces between two slides and hold them together with a spring clip. Leave them in that position until they are dry and flattened; then remove and mount in balsam.

Crystals of Urine.—Urine is an exceedingly crystalizable substance and slides are very easily prepared for the polariscope. Let it settle in a conical glass from twelve to twenty-four hours. Take a portion of the sediment in a pipette and place it in the center of a slide. Cover the slide so as to

keep out dust, but do not use any cover-glass. In a short time (from one to two hours), the whole will be a mass of crystals. Let them dry in the air and then mount in benzole balsam. Most of these crystals are brilliant polariscopic objects but perhaps a few will not polarize. Triple phosphates do not settle but form a film on the surface; this film can be transferred to the slide with a spatula and be treated as above directed. The pathological significance of these crystals can be learned by consulting the plates of the numerous works devoted to medical microscopy.

Sections of Potato.—A very good and instructive section of potato can be made with a razor. Trim away the thick parts and place the thin section in the center of a slide. Flood with alcohol in order to dry the specimen. This flooding will wash out a great deal of the starch from the cells and leave other cells full. This washing increases the interest of the slide, as thereby you can contrast the empty cells with the others. When perfectly dry, mount in balsam and view by polarized light. It is an interesting specimen with ordinary light, but its beauty is enhanced a thousand fold by polarization. Do not stain the specimen. Beauty is, when unadorned, adorned the most. Staining will only destroy the natural beauty of the object.

How to Examine a Water Supply.—Tie a small bag over the spigot of a wash basin and let the water run until the bag gets like a sausage; then remove and empty it into a conical glass; and when it has settled, examine the contents. Always turn the bag wrong side out and wash it into the water you desire to examine. Some of the best specimens adhere closely to the cloth and even stick in its meshes. Any cloth of fine texture will answer. The little cloth sacks in which smoking tobacco is put up for sale will answer the purpose well. If the bag be too large, too thick, or too thin, it will not work well. The spigots over the sink in kitchens are too large and do not give satisfactory results. There are also a number specimens that habitually rise to the top and this top should always be examined. On the surface will be found some of the rarest specimens. First examine the top in a cell and with an inch objective. The examination of water is interesting at all times of the year.

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THE MICROSCOPE.

NOVEMBER, 1893.

NUMBER 11. NEW SERIES.

OBJECTS SEEN UNDER THE MICROSCOPE.

III.—NATURE'S JEWELS (DIATOMS).

[PHOTO-MICROGRAPH.]

The Diatom here presented is the *Surirella gemma*. There are nearly 60 species of the genus *Surirella*. This is a marine form and measures about 1-240 of an inch in length. The cut shows an enlargement of 1200 times.

This photo-micrograph was made by Nachet of Paris by means of a 1-10 oil immersion objective, and the bringing out of the minute pearls is considered a great feat. They are shown somewhat better in his original than in this engraving. Nachet is perhaps the best maker of microscopes in France.

To those unfamiliar with diatoms, we may say that this very minute form is a plant, whose shell naturalists call a frustule. The soft parts, when present, more easily disappear leaving the frustule in sight. The illustration presents a side view of a frustule unaccompanied by any soft parts. A front view would be of quite different shape and an end view still more so but of less interest. This hollow frustule consists of two halves called

valves which fit together along the median line running from end to end (and which shows so conspicously), much as the cover fits upon a pill-box.

The cavity or resulting enclosure is of many different shapes in different species of diatoms and serves for the reproduction of the species. One of the valves is always older than the other and the hoop of the older valve partly encloses the younger. As growth progresses the outer hoop slides off the inner one until often there is but very little overlap.

The species is perpetuated and increased by each frustule dividing into two frustules and so multiplying its numbers indefinitely. After the death of each plant the frustules remain and may last for centuries if buried under favoring conditions, or otherwise preserved.

A METRIC STUDY OF TWO THOUSAND CHECK SIGNATURES.

By Dr. Marshall D. Ewell,
Chicago, Ill.

The various methods of committing forgery and the means available for its detection were discussed by the writer in the *American Law Register*, Vol. xxix, 1890, p. 553. In that paper we stated that perfect identity of two signatures is very strong, if not conclusive, evidence of fraud, referring to the famous Howland will case, which will be found abstracted on p. 562 of the same volume.

A similar question arose in the case of the will of late Senator Joseph E. McDonald, recently tried at Nobleville, Indiana, in which the verdict was that the will was a forgery.

In the preparation of that case it was thought expedient to investigate the question of the length of signatures written in the ordinary course of business by the same person, with the view of ascertaining, if possible, the law, if any, governing the same. With that end in view the writer measured the length of 700 of his own checks drawn on the First National Bank of Chicago between the years 1884 and 1888, and also 300 checks drawn on the Merchants' Loan and Trust Company in the years 1891 and 1892. The former were drawn on smaller blanks than the lat-

ter, and hence will be separately discussed for reasons hereinafter stated.

Six hundred and twenty-six check signatures of Mr. Alpheus H. Snow, 133 of Mr. Parke Daniel, and several hundred checks signatures of other parties were also examined.

While making these measurments we also compared the checks of the same persons respectively *inter sese*, with the view of finding, if there were any, such as were exactly, or within very narrow limits, identical in size and form, but found not a single instance of such identity. We had not proceeded far in the investigation before it became apparent that the length of the signature depends to some extent upon the length of the line upon which it is written; and that even in cases where the line is longer than is necessary for the signature, as ordinarily written, it invariably affects the length of the signature; so that the average length of the signature diminishes with the length of the line upon which it is written. It is obvious, therefore, that there can be no settled mean length of signatures unless they are written upon lines of substantially the same length. By *lines* in this connection is not meant lines running entirely across the sheet of paper, but such lines of convenient length as are usually found upon blank checks and other similar documents. Having arrived at this conclusion, we endeavored to ascertain whether those signatures written on similar blank checks under substantially the same conditions were governed, as we suppose, by the general law of probability, so that the platted curves hereinafter described, would form what is known as the "probability curve."

The results arrived at were not conclusive upon this point, though we are of the opinion that, given a sufficiently large number of signatures written upon similar blanks and under the same conditions, they would be governed by the law above referred to.

The method adopted was as follows: The lengths of the separate signatures of each person were added together and the sum divided by the number of signatures, giving the mean length. The length of each separate signature was then subtracted from this mean length, giving a series of remainders *plus* and *minus*. These residuals were then classiffied and curves platted in which the ordinates represent the number of signa-

tures and the abscissas their residuals, plus and minus. The result of this labor, which was not inconsiderable, did not entirely realize our expectations, though in the scientific examination of any question even negative results are valuable.

The will of Mr. McDonald was alleged to have been executed in duplicate. A counterpart was originally propounded for probate: the other counterpart was a carbon copy of the first. The signatures to the two counterparts were substantially identical. No cut could disclose this identity as satisfactorily as an inspection of the originals.

The following conclusions seem warranted by the facts:

(1) The two signatures of the alleged testator, Joseph E McDonald, and the alleged subscribing witness, Parke Daniels, are so nearly identical as to warrant the conclusion that the will is a forgery.

(2) The length of the signatures of the same person depends to some extent upon the length of the lines upon which they are written, increasing and decreasing with the same, even when such lines are ample in length for the ordinary signature of the writer.

(3) No satisfactory conclusion can be predicated as to the length of a signature under ordinary conditions as they occur in practice, unless a large number of genuine signatures is available, and then only when the disputed signature falls considerably beyond the limits established by such signatures.

KENT LAW SCHOOL, CHICAGO, ILL.

AN AQUEOUS SOLUTION OF HEMATOXYLIN WHICH DOES NOT READILY DETERIORATE.

By SIMON HENRY GAGE,

ITHACA, N. Y.

[From Proceedings of the American Microscopical Society.]

For most of the purposes of histology there is a no more satisfactory and generally applicable stain than hematoxylin, and experience has shown that aqueous solutions are on the whole preferable to those containing a considerable quantity of alcohol. Every microscopist knows, however, that aqueous solutions of hematoxylin soon begin to deposit a dark precipitate on the

bottle and become filled with granules and frequently with threads.

As so many changes are due to living ferments (organized ferments, as bacteria, yeast-like fungi, etc.), it occurred to the writer that the deterioration of the hematoxylin might be due, wholly or in part, to one or more of these organized ferments. If this supposition is correct, any ferments accidentally present in the water and alum used, should be destroyed. If then some substance is added to the solution to prevent the development of germs that might subsequently get into the solution, the solution would be likely to be lasting and to retain its excellence. Experiments proved the accuracy of the hypothesis. An aqueous solution of hematoxylin prepared as directed below and made nearly a year previous to the present writing is still in excellent condition. During the year it has been in the laboratory and subjected to all the vicissitudes of heat, dust, light, and all the other conditions that an ordinary histological re-agent must endure. It has remained in the same bottle all the time, and now, after nearly a year, there is no deposit on the bottle, and the stain acts as well as in the beginning.

Formula:

Distilled water.....200 cc.
Potash or ammonia alum.....7½ grams.
Chloral hydrate.....4 grams.
Hematoxylin crystals.....1-10 gram.

To prepare the solution, place the water and alum in an agate or porcelain vessel and boil for five minutes or more, preferably fifteen or twenty minutes if the water is not freshly distilled. This boiling will destroy any germs in the water or alum. Allow the boiled alum solution to cool, and add sufficient freshly boiled distilled water to compensate for evaporation and make 200 cc. of alum water. Add the chloral hydrate and dissolve the hematoxylin crystals in 10 cc. of 95 per cent alcohol and add to the mixture.

At first the color will be rather faint, but after a week or two it will become a deep purple. The deepening of the color is more rapid if the bottle is left uncorked in the light and is shaken occasionally.

If the stain is too concentrated it may be diluted with freshly distilled water or with a mixture of water, alum, and chloral.

If the stain is not sufficiently concentrated more hematoxylin may be added. With hematoxylin of the strength given in the formula, sections are usually sufficiently stained in from one to five minutes.

As may be inferred from what was said above, the boiling is to destroy any living ferments present in the water or alum, and the chloral hydrate is to prevent the development of germs which accidentally reach the solution after it is made.

No precaution is necessary in using this stain for sections, except that applicable to all hematoxylin solutions, viz: after staining, the surplus stain must be very thoroughly washed away with distilled water; otherwise black granules or needles will appear in or upon the sections. If granules appear in the preparations in spite of the washing, it will be well to boil the solution three to five minutes and filter through paper or absorbent cotton. The addition of one or two per cent of chloral after the boiling is also advantageous. This stain has not been tried for dyeing in bulk. Other substances than chloral were tried, but not with so good success. For stains other than hematoxylin, chloral might not prove so satisfactory a preservative.

As hematoxylin is for most tissues, almost a pure nuclear dye, it has been found advantageous to stain the cell body, ground substance, etc., with a general or counter stain. One of the most satisfactory of these is eosin, prepared as follows:

Distilled water..... 50 cc.
95 per cent alcohol..... 50 cc.
Dry eosin..... 1–10 gram.

The eosin is used after the hematoxylin in most cases, and, as it is in alcoholic solution, it may be washed off with 95 per cent alcohol if the object is to be mounted in balsam. If it is to be mounted in glycerin or glycerin jelly, the excess of eosin should be washed away with distilled water.

An excellent counter-stain for many objects is picric acid. One proceeds with this as with the eosin, except that a saturated alcoholic solution is made and after the hematoxylin is washed away a drop of the picric acid solution is added. This is then washed away with 95 per cent alcohol. The time required for the eosin or the picric acid to stain is very short, usually only a few seconds.

SECTIONING FERN PROTHALLIA AND OTHER DELICATE OBJECTS.

By M. B. THOMAS,

CRAWFORDSVILLE, IND.

The material to be sectioned is first hardened by placing it in 10 per cent alcohol in a dehydrating apparatus and allowing it to remain for 24 hours. It is then taken out and placed for 1 hour in 95 per cent alcohol to insure complete dehydration after hardening. After this the tissue is placed in a 1½ per cent solution of collodion and allowed to remain in a tightly corked vial for 12 hours. (The collodion is best made by dissolving 1½ grams of gun cotton in 100 c. c. of equal parts ether and alcohol.)

The cork is then removed and by slow evaporation of the ether and alcohol the collodion will thicken. When it is of the consistency of ordinary glue the tissue is taken out and placed in a paper boat, of the kind used in paraffine imbedding, or an ordinary watch glass will answer the purpose. The thick collodion is then poured over the tissue and it is allowed to harden in the air until a firm film is formed over the surface.

It is better to pour out the tissue from the vial with the collodion and thus prevent it from being broken by handling.

After the firm film is formed the dish is placed in a jar of 85 per cent alcohol and allowed to remain from 5 to 6 hours until the collodion is quite firm. Then with a thin knife cut out a block of the collodion containing the tissue inside.

The block can be placed in any desired position on the end of a cork and held while thick collodion is poured over it until enough is applied to completely cover it. Each coat as added should be allowed to slightly harden before applying the next until the operation is completed.

After this is accomplished and the whole allowed to partially solidify in the air, the material is placed in a jar of 85 per cent alcohol where it should remain to harden 6 to 8 hours.

The cork can be fastened in the jaws of any sliding microtome and serial sections of any desired thickness made in the usual way.

The knife should be kept wet with alcohol during the operation, and the sections removed from the knife to the slide by means of camel's hair brush.

After the sections are arranged they can be fastened to the slide by blowing over them ether vapor or by placing a few drops of ether on the slide and allowing it to spread until the collodion is melted.

After the sections are fastened they can be stained, cleared and mounted in the usual way.

In order that the sections may be all arranged the same side up, the block of collodion, which should always be trimmed at the top, can be cut with a notch near one corner and the notches all arranged with the same relative position on the slide.

It will be found that with this method, perfect serial sections of any desired thickness can be obtained from objects which are not more than one layer of cells thick, and thus render the preparation of delicate tissues but little more difficult than that of the firmer kinds found in ordinary stems or roots.

WABASH COLLEGE, *Octo.* 25, 1893.

Society of American Botanists.—The botanists are at present much more active in organizing than the zoologists. They were not satisfied with having a Botanical Club in connection with the American Association for Advancement of Science, but they demanded a separate section for botany. They had previously read their papers in the Biological section. Now they are organizing a National society. The Botanical Club at Madison, Wis., Aug. 23, 1893, appointed a committee of ten which was to select enough other persons to make a nucleus of 25. These 25 are to become the charter members of the National Society. A committee on organization, headed by Prof. Wm. Trelease of St. Louis is preparing a constitution and will report next August when the 25 charter members are expected to gather at the A. A. A. S. It is understood that the membership will be limited to persons who have attained considerable prominence in botany. In the list of charter members, we notice a good many names of subscribers to the microscopical literature of the day. A cryptogamous botanist must of necessity be a microscopist.

Pasteur's Fluid is made in the proportion:—

Water 4150 parts; cane sugar, 750 parts; ammonium tartrate, 50 parts; potassium phosphate, 10 parts; calcium phosphate, 1 part; magnesium sulphate, 1 part.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

W. WATSON & SONS' CATALOGUES OF MICROSCOPES AND MICROSCOPIC OBJECTS.

In the Microscope Catalogue just issued, we notice more space given to the Van Heurck Microscope which seems to gain an increasing amount of favor and is already used by many of the most renound workers. The makers have devised a new form of rackwork draw-tube at a very low price specially for the Edinburgh Student's Microscope, and have adapted the tripod foot to this stand. Buyers can choose between this and the horse-shoe. On page 44 will be noticed particulars of Mr. Nelson's new semi-mechanical Stage as described by him at the Royal Microscopical Society's meeting in March last. We have also observed a new series of Aplanatic Magnifiers having powers to 6, 10, and 20 diameters. They give a large and flat field combined with good working distance, and are especially intended for dissecting purposes. The Laboratory Dissecting Microscope, page 57, being provided with a fitting to receive the same.

Messrs Watson have not been able, so far, to use aluminum in the construction of microscopes to any extent, but in the various pieces of apparatus have found it useful and now mount the Abbe Illuminators and the Achromatic Condenser quoted on pages 62 and 63 in that metal. Owing to the size of the Lens they are of necessity somewhat clumsy, and the aluminum affords a very considerable reduction in weight. They also

make the Abbe Model Camera Lucidas, resolving Nosepieces, and a reversible Compressor in aluminum.

In the Object Catalogue they have considerably extended the list of Bacteriological Specimens, and are now able to offer medical men and Health officers very complete sets of Specimens comprising all the principal subjects that are required by students in England for the "Diploma of Public Health." They have also revised their Botanical preparations so that in every case the best example to illustrate a particular structure may be given. Various new, popular, and show slides are also included.

This house has just received three awards at the World's Fair, Chicago, being the highest conferred on any firm of opticians, and making a total of 36 gold and other medals that have been awarded to them at International Exhibitions.

A New Book on Diatoms Proposed.—By request of the author, Dr. A. M. Edwards, we invite subscriptions to Bacilliariæ. It will contain a popular account of Diatoms in general and the mode of collecting and cleaning their shells. Illustrated, 100 pp. Price $3. Club rates to our subscribers $2.75. From this price a further allowance of 25 cents will be made to those who subscribe during November, payment to be made on publication of the volume.

Mosquitos.—There is no longer excuse for these pests existing as it has been found that a little kerosene oil poured upon a pond's surface when they are germinating will destroy millions of them. Perhaps a few should be saved for mounting as microscopical specimens. We do not want to actually exterminate them.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

172. *What is the theory and practice in the use of a mordant in bacteriology? Is it to fix the tissues or what is it for?—Enquirer.*

Some mordants act by penetrating the substance of the bacteria and assisting the entrance of the dye; and so produce a very intense staining which will resist the subsequent washings, etc. Others act by saturating the bacteria and producing therein a difficulty soluble prec pitate with the dye.

173. *Is there a difference between homogeneous and oil immersion objectives? Can prepared cedar oil be used with a homogeneous immersion objective?—Enquirer.*

It is always best to use the immersion fluid recommended by the maker of the objective; but, as cedar oil and homogeneous immersion fluid are usually prepared so as to have the same refractive index as the front lens of the objective (optical glass), either fluid may be used, as a rule.

174. *Is aniline water the same thing as aniline oil? If not, how is aniline water prepared?—Enquirer.*

Three drops of aniline oil to a dram of water, well shaken together and filtered, is called aniline water. A solution of a dye in aniline water will keep good about one week.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Collar Correction of Objectives.—The usual instruction given to a novice for the correction of his adjustable objective is to turn the collar until a clear and distinct image is obtained This is vague, indefinite, and misleading, because it is almost impossible to know when a perfecty clear and distinct image of an unknown object has been obtained. A more certain, correct, and scientific test is by color If noticed carefully, all objectives show some of the colors of the spectrum in the specimens viewed and this can be taken advantage of for the correction of the lens. The following table will solve the problem:

CENTRAL LIGHT.

When under-corrected—elevations red.
When under-corrected—depressions green.
When just right—elevations light violet.
When just right—depressions green pippin.

The above is given for immersion lenses and varies slightly with dry lenses.

Ring-worm.—I have rarely spent a more instructive and pleasurable evening with the 'scope than I did a few evenings ago when I was fortunate enough to view five different kinds of fungi. A young lady called with a ring-worm on her arm and was filled with fear of blood disease. With a spatula a little of the "worm" was scraped off placed in the center of the slide, flooded with potassium hydrate, covered and examined with a quarter inch objective when the characteristic mycelium of *Achorion schoelinii* appeared. This is pictured on page 52 of "Microbes and Ferments," Vol. LVI, of the International Scientific series. The young lady bound the spot with cotton soaked in sulphurous acid and in a few days all traces were removed.

Grape-mould.—My next specimen was a grape containing felt-like mould. Scraping off a small portion and placing it on a slide with the potassium hydrate, I had the extreme pleasure of seeing the beautiful fungus *Uncinula spiralis*, a troublesome disease of grapes. This is described and elegantly figured in the report of the U. S. Department of Agriculture for 1886, page 105, plate 2. It was a sight worth seeing and was obtained by simply scraping some grapes purchased for the table.

Ragweed.—I then took some leaves of ragweed. They were growing around the sides and under the eaves of a country town-hall. A layman claimed that the paint from the building had washed off and covered the leaves. A Coddington lens showed the little spots or conceptacles dotting the white-washed leaves. I gathered a large supply, but placed them between the leaves of a book. Arriving home, I examined first with a one inch objective as an opaque object, and then examined them as already described in the August "Microscope" p. 126, under directions for mounting *Erysiphe*. This fungus was very interesting but I found it almost buried beneath several Greek and Latin names. Dr. M. C. Cooke in his little work on "Microscopic Fungi" figures it in plate XII, figure 249, and calls it *Erysiphe linkii*. Ellis & Everhardt in their great work on American Pyronomycetes on page 12 call it *E. cichoracearum* and ition the synonyms under which it is known.

Tomato Fungus—Black Rot.—My next specimen was a tomato sunken so that half of the globe remained and the sunken surface was covered with a black powder. As usual with fungi, I examined the black powder in potassium hydrate with a quarter inch objective and found some rare fungus. For want of sufficient library on the subject I feared that I would be unable to answer the question oft put to the microscopists: "What is it?" But I chanced to remember that I had seen a picture similar to my tomato in one of the U. S. Agriculture reports and I soon found it in the report of 1883 described on page 339 as the black rot of the tomato and figured in a colored plate. as *Macrosporium solani*. The spores were quite dry and I mounted them in benzole balsam without any previous preparation.

White Rust.—My last specimen was a small piece of tomato some one had sent me in a small bottle. Taking a small particle, I pressed it down with a cover, examined with a quarter inch and saw the conidia of white rust, *Cystopus candidus* just as the same is figured in plate X, figure 200, of "Microscopic Fungi" by Dr. M. C. Cooke.

SCIENCE-GOSSIP.

Milk— is probably the worst medium of infection in tuberculosis and several other bacterial diseases.

Pixol— is a new disinfectant but it has failed as regards cholera. It is a solution of tar in which the comma bacillus has been exposed 16 hours without effect. Boiling is the surest method of disinfecting.

Flagella.—The character of the flagella on several kinds of bacilli has been investigated by Dr. V. A. Moore and published in a volume called "The Wilder Quarter-Century Book." Those interested in the subject should write to him for a copy. His address: Washington, D. C.

Our Own Birds— is the title of a book just issued by Lippincott and it is of use in identifying the common birds.

Botany.--Botany need no longer be taught as of old—merely for identifying species. Vegetable physiology should take the first place in the student's thoughts. The teacher can give the names of the plants studied and let the student use his microscope upon the bacteria, the smuts, the mildews, and rusts.

Vienna— is to have a Pasteur Institute in connection with one of its large hospitals.

Banknotes—carry microbes. On a note that had circulated some time 19,000 microbes were found, including the bacilli of tuberculosis and of diphtheria and the streptococcus of erysipelas.

The GWA Mixture.—This is an abbreviation for glycerine (1 part,) water (2 parts,) alcohol (3 parts,) and is sometimes called the 1-2-3 mixture. It is used for soaking vegetable sections before mounting them in Farrant's medium.

Triassic Diatomaceæ.—Dr. A. M. Edwards reports (*Am. Nat., Sept.* 1893), finding diatoms in a clay pit near Passaic, N. J., which he considers to be the first ever found in that geological formation. This Triassic clay contained *Gomphonema acuminatum* and *Brebissonia lanceolata* associated with sponge spicules.

Deane's Medium.—Soak one oz. gelatine in 4 oz. of water until the gelatine becomes soft, add 5 oz. of honey heated to a boiling point, boil the mixture, then cool (but not stiff) add ½ oz. of rectified spirit and 5 drops of creosote. Filter through fine flannel.

RECENT PUBLICATIONS.

Text-Book of Normal Histology. By Geo. A. Piersol, M. D. 8°. 439 pp. 300 illustrations. $3.50. Phila. 1893. J. B. Lippincott Company.

In the preparation of the text, the author has supplied descriptions of the various tissues and organs; these, while at once clear and brief, nevertheless avoid too great conciseness, which, where fact follows fact in rapid succession, proves bewildering to the student; at the same time, the subjects are considered with sufficient completeness to assure an adequate presentation of important details. The systematic arrangement adopted brings the most essential matter into prominence so that it may be selected and assimilated readily by the student.

The paragraphs devoted to histogenesis will be found additions of value as pointing out the fundamental relations existing between many tissues and organs, and as emphasizing the

broader morphological basis upon which structural anatomy at present rests. An appendix devoted to microscopical technology supplies detailed instructions concerning the important methods of work, a mastery of which is essential for every one proposing to undertake histological investigation; the author's extended and varied experience renders his suggestions often of especial value.

The illustrations of the book will be found particularly interesting, since the author has accomplished the no inconsiderable task of preparing new and original drawings for the entire field of normal histology. With few exceptions the drawings are based upon camera lucida sketches or photo-micrographs, and as far as possible represent human tissues; while retaining sufficient diagrammatic clearness to render them thoroughly efficient as aids in comprehending the descriptions of the text, they are faithful likenesses of the actual structures.

The Psychic Factors of Civilization. By Lester F. Ward. Boston. Ginn & Company, 1893. 8vo. Cloth, 369 pages. By mail, postpaid, $2.00.

This work, like its predecessor, Dynamic Sociology, makes a bold advance into philosophy. It is not too much to say that it deals with the most important questions before the world and brings out some startling results. It shows that, notwithstanding the amount of attention that has been devoted to mind, the leading truths connected with its origin and development have been overlooked. It also shows that the true influence of mind in human history and civilization is little understood, and that its existence as a factor in political economy and social science has been deliberately ignored. The object of the book is to prepare the way for *a social science based on mind*, and to foreshadow a new political economy that shall recognize man as a rational being. In a word, it is a powerful protest against the sterile philosophy and dismal economics that have so long prevailed, and is itself a philosophy of hope based on faith in the efficacy of rational scientific action.

The work is embelished with a fine array of quotations, mottoes, and literary gems, so that it is almost an anthology of the subject. It is also provided with an annotated list of authors and titles, and a copious index.

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THE MICROSCOPE.

DECEMBER, 1893.

NUMBER 12. NEW SERIES.

OBJECTS SEEN UNDER THE MICROSCOPE.

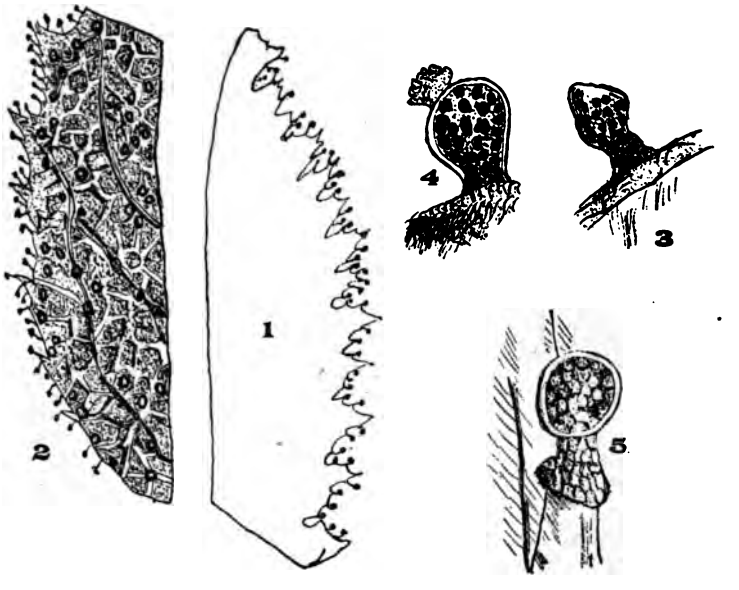
IV.—ONE OF THE RED SEA-WEEDS.

[PEN DRAWINGS.]

In Figure 1, you have a view of this delicate object magnified only ten diameters. It is known to naturalists as *Callithamnion roseum* and we are indebted to the late Tuffen West for the illustrations which we have redrawn from the International

Journal of Microscopy. (This Journal, which is published in England at $2.75 per year, we can supply to our subscribers at a very low price). In Figure 2, you can see one of the little branches magnified 50 diameters. Figure 3 shows a portion of

the main stem magnified 100 diameters. The round bodies on Figure 2 are called favellæ (honeycombs) and consist of groups of spores covered with a thin gellatinous membrane. One of them, enlarged to 200 diameters may be seen in Figure 4, in which appear the four spores (hence called "tetraspore"). Figure 5 is a spore receptacle called a "ceramidium." Figure 6 shows how fruit sometimes originates from a special modification of stunted branches. These spores are believed by some to be non-sexual and to need no fertilizing. If they thus grow to be plants without the aid of any sexual organs, they illustrate one

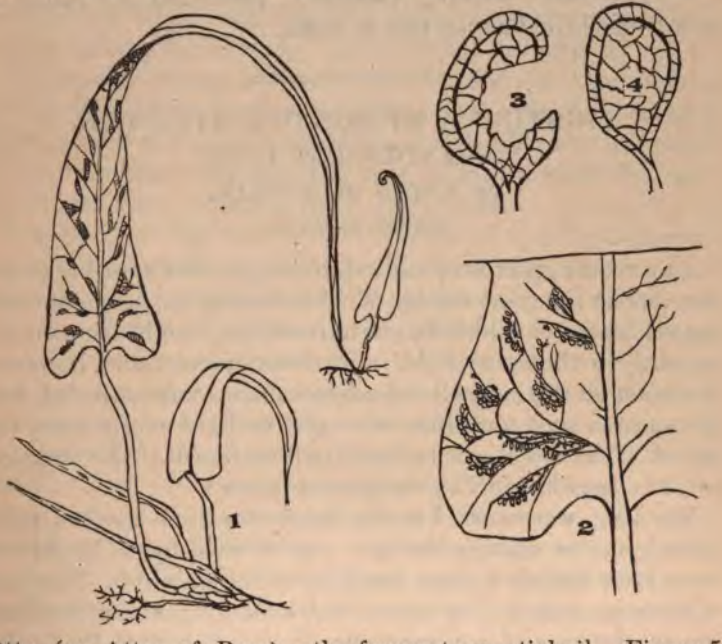


of the lowest forms of vegetable life. Of much interest also is this metamorphosis of branches into fruit-bearing organs—a very unnatural procedure, we should say. Two forms of fruit are produced by these two different means.

These sea-weeds grow in deeper water than other sea-weeds and often they exhibit the richest of tints. They should be looked for by every one who has access to the sea coast. The red color is due to a pigment and it has sometimes been separated out in the form of beautiful regular Crystals. For further information, see Carpenter, pp. 559-561.

V.—GLANDULAR HAIRS ON SWEET BRIAR LEAF.

Figure 1 shows a portion of the upper surface of a Sweet Briar Leaf magnified only 5 diameters. This surface does not have any glandular hairs but they may be seen projecting from the edge. Figure 2 shows the lower surface of the leaf which posseses more or less of the glandular hairs. The hairs themselves highly magnified, are shown in figures 3, 4, and 5. The tip on figure 4 is a little cap of Otto of Rose. By careful manipulation under the microscope, the cap is sometimes dislodged and then shows the semi-crystalline appearance of



Otto (or Attar of Rose),—the fragrant essential oil. Figure 5 represents the nearly colorless hairs. The interior of these ovals is filled with a soft cellular tissue.

VI.—THE WALKING FERN.

We are indebted to Mr. Fred R. Stearns of the American Magazine of Natural Science for all our information about this form which does not seem to be mentioned in any of the prominent botanies. He says that it grows in the shaded woodlands of Iowa. Figure 1 illustrates the parent plant (*Camptosorus*

rhizophyllus) whose frond, bending over to the ground, has given root to a new plant. The new plant may produce a long frond which in its turn will root a third plant. Mr. Stearns has seen three steps taken in one season, though generally one is sufficient.

Besides propagating in this manner, this fern propagates in the usual way, by means of spores. A section of leaf bearing spores is shown in figure 2, a closed spore case (sporangium) in figure 4, and a sporangium opened in order to discharge its spores in figure 3, these being magnified 400 diameters.

This peculiar "walking" method of producing new plants reminds us of the Banyan tree of India.

LIGHTING A MICROSCOPE WITH THE INCANDESCENT LAMP.

By JOSEPH HOGBOTHAM,

LONDON, ENGLAND.

At a recent microscopical exhibition, it was amusing to notice among the great variety of illuminating apparatus including oil lamps of all kinds, gas burners, etc, one instrument apparently without any light. On closer examination, however, it was found that a small incandescent lamp was concealed near the stage in such a manner as to give no light except upon the object. The object was beautifully illuminated. The arrangement is described in *The Optician* as follow:

The lamp was situated in the focus of a small silvered parabolic reflector whose wide end was covered by a blackened brass plate having a short brass tube screwed into it. This part of the apparatus looked like a swab used by gunners for cleaning out the bore of a cannon after a shot has been fired. Inserted into the small tube was a solid rod of clear glass having both ends ground perfectly plane, polished and at right angles to the axis of the glass rod. This rod may be inserted loosely or it may be soldered to the tube. It was blackened on the outside with Brunswick black or some dark japan, so that there was absolutely no light visible along the rod other than that which was projected from the end farther away from the light. The whole apparatus was so adjusted that this beam of light

was directed immediately below the object on the slide, thus avoiding all stray rays. A very small plano convex lens cemented to the end of the rod by means of Canada balsam served the purpose of concentrating the entire beam upon the object under examination. The great facility with which this was done showed that the apparatus was equal to, if not superior, to the Abbe condenser system.

There was sufficient illumination for the manipulation of the objects, and the great comfort obtained by the use of this so-called "dark lantern" more than paid for the cost of operating which was slight. This arrangement rendered the use of the eye shade, a device which is often used by the amateur microscopist, entirely unnecessary, another point in its favor.

The total refraction of the rays of light made it possible to have these light-conducting cylindrical glass rods of almost any shape. A bend may be made without any difficulty, and there can be little doubt but that they may be used as scale illuminators in well constructed electrical instruments.

The heat arising from the enclosing of the incandescent lamp in the reflector may be done away with by drilling several holes at the top and bottom of the encasing metal. A draught will thus be produced which will cool the heated interior. This heating is sometimes so intense that in one particular instance, where a green glass incandescent lamp was used in a parabolic reflector, some of the reflected rays were caught, by the green glass and absorbed, and in a comparatively short time the globe was softened, thus causing it to collapse.

The portion of the glass rod to be soldered to the brass tube should be prepared as follows: Coat it evenly with a dilute solution of platinic chloride, and deposit the metallic platinum by dipping into an essential oil, such as lavender. A bright grayish conduction film is thus obtained, which may be electroplated in a sulphate of copper bath. If an even and pliable coating is obtained, it may then be treated as an independent close-fitting tube, and may be soldered accordingly. Care should be taken, however, not to heat it too much in the act of soldering, for unequal expansion is liable to cause either a fracture or a loosening of the copper coating. If this should happen the glass rod may be cemented into the tube with some material, such as plaster of Paris, which is not affected by heat.

COLLECTING ALGÆ AND DESMIDS.

By DR. ALFRED C. STOKES,
TRENTON, N. J.

[From Introduction to Keys to Fresh-Water Algæ.]

Algæ and Desmids are singly invisible to the naked eye. It is only when they occur in large masses that the eye can take cognizance of them. It rarely occurs, however, that the Desmids are so abundantly congregated that they thus obtrude themselves on the observer. When a large quantity has been collected and the vessel placed near a window, they will collect in a green film at the surface of the water on the lighted side, and there become visible in mass. In the ponds and shallows such an occurence is not common. At times they are found so abundantly that by holding a glass vessel of the water up to the light they may be seen floating about as minute green objects, which the trained eye will recognize and the pocket lens make distinct. But these varieties are among the largest of the forms; according to my experience they are always exclusively confined to the Closteriums. Other large forms, like *Micrasterias*, at least in the writer's locality, rarely occur in such profusion. To collect the Desmids, therefore, it is necessary to collect by faith. The microscopist can know exactly what he has only when he gets home and examines the water drop by drop under the microscope.

With the Algæ it is different. These are usually visible to the naked eye, as they are almost invariably collected in large masses floating on the surface, submerged just beneath the surface, or attached in waving tufts or fringes to sticks and stones and other plants in the ponds. The eye of faith is not needed to recognize them. They usually force themselves on the wondering attention of the observing pedestrian in the wayside lanes, beside the ditches and slow brooks. As soft emerald clouds, or graceful streamers floating in the sluggish current, or resting like a green scum on the surface, they are readily seen and as easily gathered. No collecting tools are demanded for either Algæ or Desmids, except a dipper of some kind, a common tin dipper is as good as anythig, and a few bottles or other vessels to carry the treasures home, and to keep them concealed from inquisitive people; the collecting naturalist must always be prepared for a meeting with such persons.

GENERAL DIRECTIONS FOR MICROSCOPIC WORK.

By PROF. E. S. BASTIAN,

CHICAGO, ILL.

[From his College Botany, pp. 218-9.]

1. Acquaint yourself thoroughly with the mechanism of the microscope you are to use.

2. Observe great care in the removing and putting on of objectives, so as not to drop them, for they are delicately constructed and liable to injury. The eye-pieces and eye-piece micrometer should also be handled with care.

3. Observe care in focussing, particularly when high powers are used, so as not to run the objective down against the slide and endanger either the cover-glass or the objective itself. Be sure also that you focus the microscope accurately, otherwise the structure of the object will not be distinctly seen.

4. Give due attention to the adjustment of the reflecting mirror, so as to secure the most favorable illumination of the object. Much of your success in seeing fine details of structure will depend upon the care exercised in this respect.

5. Bear in mind that many of the reagents used are corrosive and hence should not be brought into contact with the microscope. All the acids and iodine reagents will act upon brass work, potassium hydrate will corrode glass, and alcohol will remove the lacquering from the stand.

6. All objects examined in liquids should be covered, not only to obviate the danger of injuring the objective, but to avoid the inevitable distortion of the image which a curved or uneven liquid surface produces.

7. Let cleanliness and care characterize all your work in the microscopical laboratory. Keep all your apparatus, slides, cover glasses, etc., scrupulously clean. Do not touch the glasses of the objectives or eye-pieces with your fingers, for that would be to soil them and impair their optical performance. Whenever they need cleansing, breathe upon the glasses and wipe them either with a piece of perfectly clean and soft linen cloth, or with a piece of the thin, soft paper that is sold at dental supply-stores under the name of Japanese filter paper. A convenient way is to keep always at hand, in a place secure from dust, a quantity of this paper cut into suitable sizes. It is useful, also,

for cleaning cover-glasses, slides, etc. If a fresh piece is used each time for cleaning an objective, there will be little danger of marring the polish of the front lens.

Keep the bottles containing reagents, staining fluids, etc., stopped when not in use, so as to exclude dust and prevent evaporation; and take especial care in using them not to introduce impurities into them.

8. In cutting sections, the razor or section-knife should always be very sharp, and for most purposes sections should be cut quite thin. Steadiness in cutting is secured by resting the wrists against the body. The knife should be given an oblique or sliding motion when drawn through the object. Quite hard tissues may be successfully cut if the sections are cut quite thin, but if the edge of the knife is allowed to run too deep, it is liable to be notched. Portions of thin structures like leaves, petals, etc., may readily be sectioned by placing them between pieces of Elder or Sunflower pith. Always clean the knife after cutting with it, and do not allow fragments of tissue to dry upon it. Sections of fresh tissues, or of those that have been preserved in any of the preservative fluids, should immediately be placed in liquid after cutting, to prevent air from getting into the cells.

9. In all your work with the microscope, proceed understandingly. Endeavor to know the reason for every test you are called upon to apply, and be careful in interpreting the results of each test. Do not rest satisfied until you thoroughly understand every tissue and structure given you for study.

10. It is excellent practice for the student to keep an accurate record in writing, and by means of drawings, of all the facts observed and the work done by him in the microscopical laboratory.

Flies and Contagion.—A fly was infected with cholera and allowed to feed upon some beef. The meat was in due time found swarming with the bacteria. If Cholera ever gets a start in Washington it will run riot, for there are, every summer, in this city more flies to each acre than can be found in all Paris. Only those who screen the flies out of their houses may expect to escape and even then contagion may come in on meat and other eatables. Sufficient heat, however, will sterilize the food.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Sterilizing Milk.—Milk should be sterilized at the earliest possible moment and milk-sterilizing depots should be established for the purpose. A reform is needed also in milking, cleaning stables and cows, and in handling of milk. To-day, milk is a dangerous medium for transmitting disease germs.

An epidemic of diphtheria has recently occurred in Hightstown, N. J., supposed to be due to infected milk. All the cases were upon one milk route, the town being divided into six different routes. In one family the parents drank the suspected milk and had the disease. The children, who were fed from a different source escaped. As soon as the suspected milk was prohibited the epidemic ceased. The milk was infected by the milk boy who had had a mild form of diphtheria for ten days before and continued at work with these germs about him. Boards of Health are more and more learning to look to the milk for explanation of epidemics, and careful people are learning to be very cautious about their milk supply.

Study of Mosses.—An illustrated guide to British Mosses with 59 plates has just been issued by Rev. H. G. Jameson. Its great merit is in enabling anyone to identify mosses almost at sight by reason of the careful key and the accurate pictures. The book describes the structure of mosses, the apparatus needed

for their study and fits one for a happy time over the mosses.

We hope some one will prepare a similar book on American mosses.

Microbes on Postal Cards.—Bacilli have been found alive after 20 hours existence on a postal card. A letter was infected by cholera bacilli, put into the mail; when taken out 24 hours later the bacilli were alive.

Microscopes for Druggist.—The number of Druggists who own and can use a microscope is rapidly increasing owing to the adulteration of drugs and other causes. The instrument is being used in the colleges of pharmacy and state associations begin to have sections of microscopy.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

175. *What is an aplanatic system eye-piece?—S.*

An aplanatic eye-piece is usually one of the achromatic forms (such as the Priscopic), in which spherical aberration is, as nearly as possible, eliminated. Any eye-piece presenting a flat field with no peripheral distortion is aplanatic.

176. *What is the highest power objective yet made?—S.*

The 1-75 inch objective made by the late R. B. Tolles, of Boston, in 1878, and owned by Dr Ephraim Cutter of New York, is probably the highest power objective yet made for actual work.

177. *What is Heliomicroscopy?—S.*

Heliomicroscopy means the use of direct sunlight for illuminating the object, either for critical resolution or for the projection of the image on a screen.

178. *I have 30 mounted diatoms and wish to classify and name them. What books do I need for the purpose?*

The Am. Mo. Mic. Journal, Vol. xii, (1890), contains a series of papers on the life history and classification of diatoms.

179. *Are the prices quoted in the advertisement of Watson & Sons, in the Microscope, the prices in the United States duty paid?—G. H. G.*

No. They are the prices in London, the purchaser to pay freight and duty.

180. *I have a ¼ inch objective and desire a higher power for the study of vegetable histology. Would a 1-7 inch, or ⅛ inch, dry objective, student grade, serve the purpose? My time for microscopic work is limited. Would I be able to get satisfaction from an immersion lens, working one or two hours daily?—G. H. C.*

A low angle, dry 1-7 inch, or ⅛ inch objective would not be satisfactory in practice. A ⅛ inch, or ¼ inch, immersion lens will give cleaner and brighter images and is to be preferred. Get an oil immersion objective. It will have a good working distance, and respond to a comparatively small movement of the collar. Such an objective is easier to master than a water immersion lens, and will give much better satisfaction in actual work.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

An Evening With Mosses.—The other evening a scientific friend called to have me show him some mosses with my 'scope. He had twenty-five or thirty different species that he had gathered, named, and mounted. The mounting was quite unique. Spreading the plant without any mounting medium upon a glass slip, taking pains that all parts should be displayed, he covered with thin glass or mica and fastened the covers by pasting strips of paper at their margins. On these slips he wrote their generic and specific names. The specimens looked elegant either as opaque or as transparent objects.

Mounting of Mosses.—The method above described is a quick way but requires a great deal of patience to get the leaves spread out and the fructification displayed. As the tissue is a light cellular tissue with no vascular parts, I find that balsam, especially benzole balsam, is a suitable medium. To mount, use a shallow cell. Tease and soak the specimen well in alco-

hol, then soak in turpentine and mount in balsam immediately.

When mounting in balsam use a 7-8 circle or a rectangular cover. Be sure that the space to be covered is well filled with the mounting medium; too much is better than too little. It will frequently be necessary to hold the cover down until the balsam sets. Hold down in the center with a rubber tipped pencil, press out all air bubbles and take care that the balsam fills the space beneath the cover.

The leaves are of a beautiful refreshing green and the calyptræ or fruit capsules and the teeth of the peristome are instructive and beautiful objects.

As opaque objects they may be mounted in the same way by adding a dark back ground. A collection of mosses will furnish enough material to keep one busy all winter. Before mounting, read up Bryophyta in Bessy's Botany, Mosses in an Encyclopedia, in Carpenter on the Microscope, or consult some special work. In this way, a mastery of the subject can be attained together with a proper judgment as to what is to be seen and mounted. Carpenter recommends mounting them on wooden slides.

The Circulation of the Blood.—In a tumbler of Algæ, I noticed three or four objects about a quarter of an inch in size, moving vigorously about. Placing one in a shallow cell, filled with water and covered, I examined with an inch objective. I think it was some sort of aquatic larva. But what attracted my attention and filled me with delight was the beautiful display of the general circulation of the blood. On viewing with the quarter inch objective the Eliptical Corpuscles were plainly and beautifully visible, the action of the heart was revealed and the circulation observed in every part of the body.

How to Spread Blood for Examination.—Select for a spreader a plain glass slip with a smooth and true edge. Place the drop of blood on a slide to the left of the center. Press the spreader tightly on the slide and draw it firmly to the right. For immediate examination place a thin cover over the center. The capillary attraction and the adhesive qualities of the blood will cement it quite securely. It can then be examined even with an immersion lens if care be taken to let none of the fluid the cover. For a permanent mount omit the cover,

let the slide thoroughly dry, on a turn-table, wipe off all the film except the circle to be covered, then stain and mount in balsam. The staining method of the late Dr. A. Y. Moore, described in THE MICROSCOPE some years ago is the quickest and best staining method I have ever used or seen described. It was accomplished by preparations of eosin and by that method blood with a nucleus could be easily double stained.

RECENT PUBLICATIONS.

The Pursuit of Happiness. By Daniel G. Brinton, LL. D. 12°, 292 pp. Phila., David McKay: 1893.

The anticipation awakened by the announcement of a book by Dr. Brinton is naturally great. He has been known for years as one of our most distinguished ethnologists. We expect therefore, something on happiness far above the ordinary—something scientific. And we get it. Happiness is defended as a legitimate pursuit and we are told how to attain it. We are not asked to be miserable now with great expectations for the distant future, but to be happy now as the condition for doing the most good. We are to seek such happiness even in food and drink. "In Paris where the art of cookery has its home and the Prohibition party no adherents, dispepsia is scarcely heard of, and the arrests for drunkenness during the year 1890 were only 38." To which the writer would add that during a four months residence in Paris, he never saw anybody refuse wine and he saw only two intoxicated persons, neither of whom was a Frenchman. Any one who has seen happiness in Paris can appreciate the philosophy of Dr. Brinton's splendid book.

Check List of the Plants of Kansas. By Bernard B. Smyth. Price 25 cents.

Copies can be obtained by addressing Mr. Smyth at Topeka, Kans. Nothing is included below the ferns and mosses. The list will be useful to botanist who make collections. Mr. Smyth offers collections for sale, 20 specimens for a dollar.

Bibliography of the Chinookan Languages. By J. C. Pilling. Bureau of Ethnology, Washington, pp 81. 1893.

This pamphlet deserves a notice on account of it containing the completest and most scientific illustration of the extended method of making bibliography yet published.

THE MICROSCOPE.

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1894.

During the coming year, the MICROSCOPE will continue and expand its popular features. People not accustomed to the use of these instruments will be able to appreciate pictures of invisible life. Arrangements have been made to illustrate each number in the style of the present issue. Dr. Shanks will continue the Replies to Queries, and each subscriber will be privileged to submit 10 questions. Mr. Willson will continue the Practical Suggestions. Dr. C. Q. Jackson of Pittsburg has accepted the Department of Science-Gossip. Whatever will tend to increase popular interest in the Microscope will receive our cordial support.

In order to enable our new subscribers to get back numbers, we have saved 50 sets of the New Series and will supply them as follows:

Nos. 1-12, (1893) $1.00.

Nos. 1-24, (1893 and 1894) $1.75.

Nos. 1-24, and a year of the Micro. Journal $3.25.

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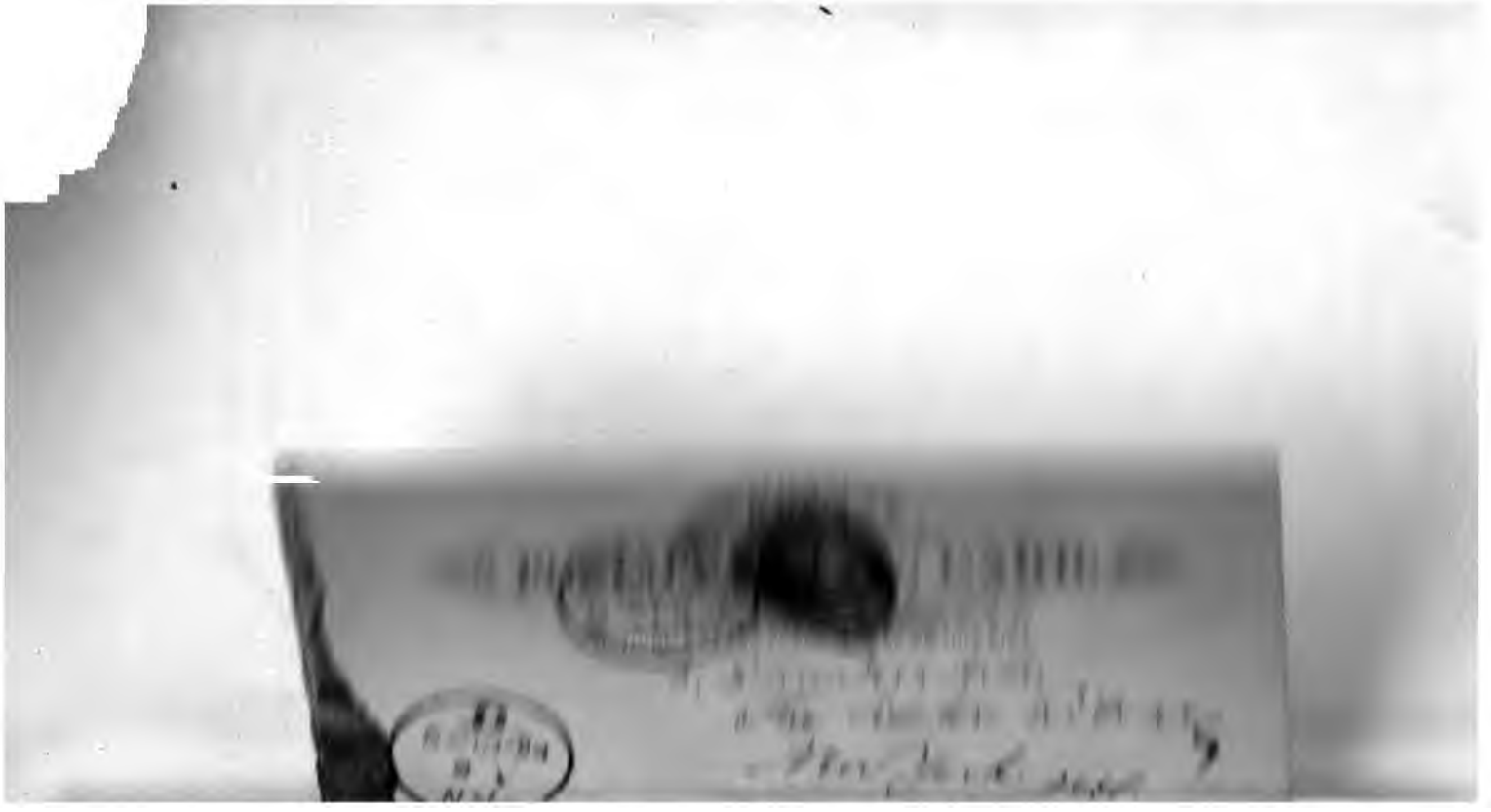

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Respectfully Chas. W. Smiley

HM